# GEOSCIENTIST

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The Fellowship Magazine of the Geological Society of London

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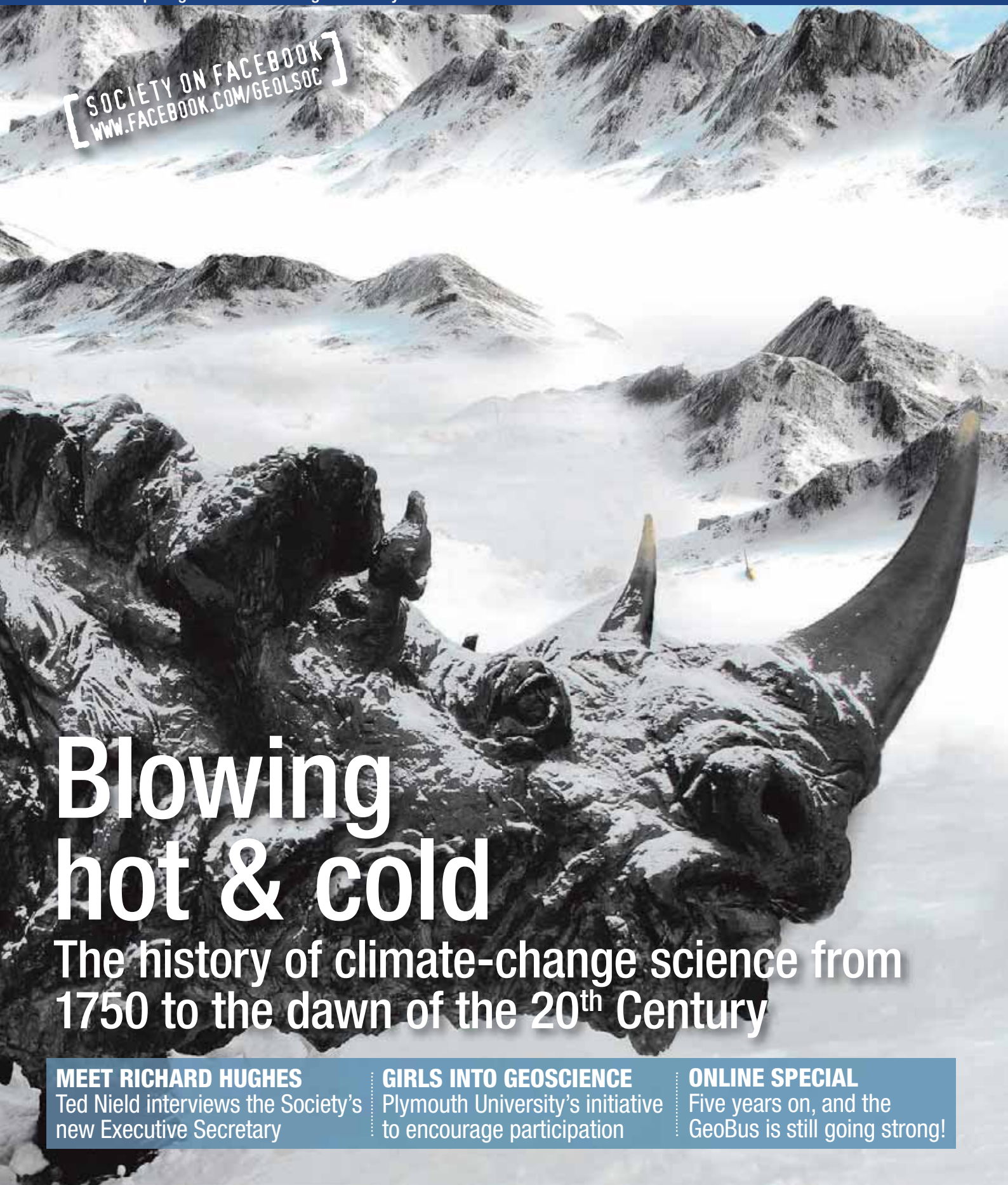


# Blowing hot & cold

## The history of climate-change science from 1750 to the dawn of the 20th Century

**MEET RICHARD HUGHES**
Ted Nield interviews the Society's new Executive Secretary

**GIRLS INTO GEOSCIENCE**
Plymouth University's initiative to encourage participation

**ONLINE SPECIAL**
Five years on, and the GeoBus is still going strong!

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*serving science & profession*

Deer, Howie and Zussman

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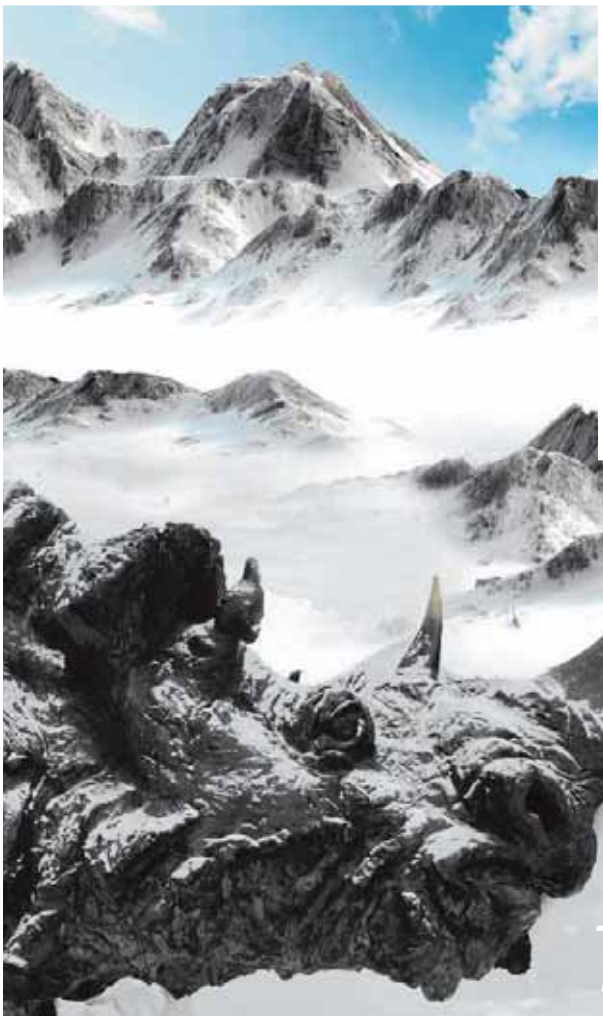


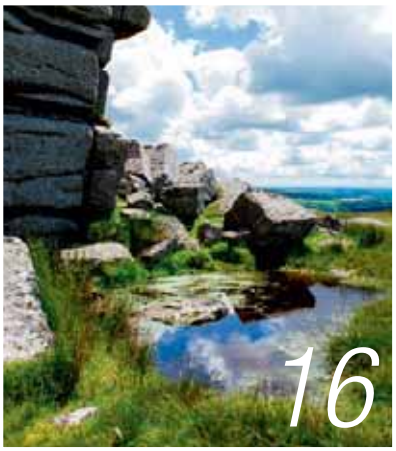




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**ONLINE SPECIAL**

**THE GEOBUS JOURNEY**
Five years on, the **GeoBus** is still going strong - making more stops than ever across the country to deliver Earth science educational resources in schools. **Jennifer Brooke** reports

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## REGULARS

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> STEREOTYPES, NO MATTER HOW OUTMODED, PERSIST LONG IN THE MEMORY, PERPETUATED BY THE CLICHÉS OF FICTION

FROM THE EDITORS DESK:

# Girls into geoscience

Press officers, an embattled breed among whose ranks I thankfully no longer count myself, are used to peculiar questions – from media and public alike. In my former life, as spokesman for UK universities, one of Her Majesty's Press, curious about student recruitment by gender (in those days heavily weighted towards males), told me he was "interested in the proportions of University women". I suggested he not advertise this fact too widely. However, all institutions should ask themselves if are doing enough to attract equally from both sexes.

Ms Dany Cotton, a firefighter since her teens and since January London Fire Brigade's new Commissioner, is clearly not "a six-foot-two hairy-arsed man", as she pointed out upon her appointment. At 18, imbued with a hearty loathing for education, she eschewed the universities (which alas, on the day of writing, find themselves embroiled anew in accusations of under-reported sexual harassment in a *Guardian* investigation) - deciding instead to answer a recruitment ad for firefighters. In 1988 she was one of three women to graduate from training, and only the 30th to join the 6000-strong service. By 2010 she was deputy assistant commissioner. Now, she runs the show.

It is easy to see why older firemen might resent the irruption of women into their ranks because they feel it 'de-machos' their role, Cotton says. But in truth, the role itself has already changed. House fires are no longer common. Seventy percent of the job now involves community engagement and fire prevention work, rather than shinning up ladders and breaking down walls.

Much the same can be said of Earth science. The word 'geologist' doesn't have the word 'man' in it ('fireman' still rankles with Commissioner Cotton), but the long shadow cast by the bare-legged, if not hairy-arsed, heroics of Sir Edward Battersby Bailey and his ilk is still likely to throw a pall over the enthusiasm of young women making their choices in education (see p. 16). Stereotypes, no matter how outmoded, persist long in the memory, perpetuated by the clichés of fiction.

When 'firefighting' on behalf of universities was my trade, tackling headlines about harassment (usually, though not exclusively, of females by males) was always the most difficult. But as in all public relations, the secret is coming clean, admitting what must be admitted, and showing you are taking action. The gender balance in university science courses today has improved to 60:40 males to females, but there is a way to go. Are we still too 'hairy-arsed'?

**DR TED NIELD, EDITOR** - TED.NIELD@GEOLSOC.ORG.UK @TedNield @geoscientistmag

# SOCIETY *NEWS*

**What your society is doing at home and abroad, in London and the regions**

## President's Awards, 2017

**The President's Awards for 2017 are made to Martin Hurst,** University of Glasgow, for his contribution to the development of innovative new techniques to better understand and model coastal erosion; and **Andrew Smye**, Pennsylvania State University, for his contribution to the thermal and chemical evolution of continental lithosphere. Congratulations to both.

## Notification of Officers for 2017/2018

**At the AGM Fellows will be asked to elect the following members of Council as Officers for 2017/18:**

**President:** Mr Malcolm Brown **Vice-Presidents:** Mr Keith Seymour, Mr John Talbot. **Secretaries:** Dr Marie Edmonds, Dr Colin North, Dr Katherine Royse. **Secretary, Foreign & External Affairs:** Dr Sarah Gordon. **Treasurer:** Mr Graham Goffey.

## President's Day

**President's Day at Burlington House on 7 June will begin with the Annual General Meeting at 11.00am followed by a buffet lunch with the award winners (members with ticket only – £27.50 per head).** As in previous years, the recipients of the major medals have been invited to give a short talk on their subject, and the Awards Ceremony will be followed by presentations by the Lyell, Murchison, William Smith and Wollaston medallists (details below). The timetable for President's Day and the agenda for the AGM are below.

➤ To obtain luncheon tickets please send cheques (made payable to the Geological Society) to Stephanie Jones at Burlington House or email **stephanie.jones@geolsoc.org.uk**. Please also contact Stephanie if you wish to attend the afternoon events for which there is no charge.

## Election Results

**The advisory ballot for Council, conducted by Electoral Reform Services, closed on 31 March.**

A total of 1962 valid votes were cast for the position of President-designate. 1829 voted in favour of Nick Rogers' name going forward to the formal ballot at the Annual General Meeting on 7 June 2017, 68 voted no and 65 abstained. Nick Rogers' name will go forward.

A total of 2017 valid votes were cast for the remaining four vacancies on Council. The results were as follows:

| | |
|---|---|
| Jessica Smith | **1255** (62.2 %) |
| John Talbot | **1044** (51.8%) |
| John Booth | **947** (47.0%) |
| Lesley Dunlop | **714** (35.4%) |
| Quentin Crowley | **670** (33.2%) |
| Bernie Vining | **626** (31.0%) |
| Neil Mitchell | **445** (22.1%) |
| Toby Strauss | **431** (21.4%) |
| Alexander Yeadon | **362** (17.9%) |

The four candidates receiving the most votes will go forward to the Annual General Meeting on 7 June 2017 for election as Council members.

### *FUTURE MEETINGS*

Dates for meetings of Council and Ordinary General Meetings until June 2017 will be as follows:

◆ **OGMs:**
**2017:** 21 June, 20 September, 22 November,
**2018:** 7 February 4 April

◆ **Council:**
**2017:** 21 June, 20&21 September (residential) 22 November,
**2018:** 7 February, 4 April

### Timetable

**11.00** Annual General Meeting (members only)
**12.30** Lunch with the Award winners (members with tickets only)
**14.00** Awards Ceremony
**15.15** Talks by Lyell, Murchison and William Smith medallists
**16.30** Tea
**17.00** Talk by Wollaston Medallist
**17.30** President's closing remarks
**17.40 – 19.30** Drinks reception

### AGM Agenda

Apologies
Minutes of the Annual General Meeting held on **8 June 2016**
Appointment of Scrutineers for the ballots for Council and Officers
Ballot for Council
Annual Report and Accounts for 2016
◆ President's Report
◆ Secretaries' Reports
◆ Treasurer's Report
Comments from Fellows
Report of Scrutineers on the Ballot for Council
Ballot for Officers
Fellowship subscriptions for 2018
Deaths
Appointment of Auditors
Report of Scrutineers on the ballot for Officers
Any other business
Provisional date of next Annual General Meeting – **6 June 2018**
**Meeting closes**

TALKS BY SENIOR MEDALLISTS

## Talks by Lyell, Murchison and William Smith medallists

◆ **Lyell Medal:**
**Rosalind Rickaby -** Professor of Biochemistry, University of Oxford.
*Coccoliths coasting through the Elderfield Curve*

◆ **Murchison Medal:**
**Tim Elliott -** Professor of Isotope Geology, University of Bristol.
*Surface environmental changes constrain rates of mantle stirring*

◆ **William Smith Medal:**
**John Walsh -** Professor of Structural Geology, University College Dublin.
*Fundamentals of faulting and the pursuit of failure!*

## Talk by Wollaston medallist

◆ **Wollaston Medal:**
**Richard Alley -** Evan Pugh Professor, Pennsylvania State University
*Crumbling at the edges: Ice sheets and sea-level rise*

## LONDON LECTURE SERIES

### Inequality in global earthquake risk today

**Speaker:** James Jackson, (Professor of Active Tectonics and former Head of the Department of Earth Sciences, University of Cambridge)
**Date:** 24 May

### Programme

◆ **Afternoon talk:** 1430pm Tea & Coffee: 1500 Lecture begins: 1600 Event ends
◆ **Evening talk:** 1730 Tea & Coffee: 1800 Lecture begins: 1900 Reception

### Further Information

Please visit www.geolsoc.org.uk/gsllondonlectures16. Entry to each lecture is by ticket only. To obtain a ticket please contact the Society around four weeks before the talk. Due to the popularity of this lecture series, tickets are allocated in a monthly ballot and cannot be guaranteed.

Contact: **Olivia Barton-Fisher,** The Geological Society, Burlington House, Piccadilly, London W1J 0BG,
T: +44 (0) 20 7432 0981 E: **receptionist@geolsoc.org.uk**

# Annual Fellowship subscriptions for 2018

Since 2015 the annual increase in Fellowship Fees has been set with reference to the prevailing annual rate of Consumer Price Index (CPI) inflation when proposals are considered in March and April for the following year. Over the past two years rates of inflation have been low and the Society has also taken a sympathetic stance towards those Fellows affected by the oil industry downturn. As a consequence, Fellowship fees have not been increased since 2015.
Last year, however, in agreeing a rate freeze for 2017 the Society indicated that inflation was likely to rise in the future and, if so, it may in future years have to raise fees at a rate over that of CPI. Inflation is starting to rise again in the UK economy and, as at February 2017, CPI stood at 2.3% (as opposed to 0.3% in both 2016 and 2015). Looking almost a year ahead to 2018, the Finance & Planning Committee considers it is likely, with the effects of Brexit starting to be felt within the economy, that the rate of inflation will climb higher and that the costs of providing services to Fellows in 2018 will reflect this. It is an established principle that the fee should cover the cost of services provided. At its meeting on 5 April Council agreed to recommend to the Fellowship for approval at the Annual General Meeting the subscription rates for 2018 shown below which equate to an average increase of 2.9% (a maximum increase of £6 on 2017 rates). The rates for Junior Candidate Fellows and Candidate Fellows remain unchanged at £10 and £15 respectively.


# Society Discussion Group

## Programme: 2017

Meetings of the Geological Society Discussion Group (formerly the Geological Society Club) are 18.30 for 1900, when dinner is served. Attendance is open to all members of the Society. For up to date information concerning topics for discussion and speakers, please go to **W: http://bit.ly/2IkAvbd**

◆ **Wed 17 May.** Gay Hussar (London W1D 4NB)
◆ **Wed 21 June.** Bumpkins Restaurant (London SW7 3RD)
◆ **Tuesday 4 July.** Denbies Winery, Dorking (Day trip)
◆ **Tuesday 19 September.** Burlington House (London W1J 0BG)
◆ **Thursday 19 October.** Athenaeum (London SW1Y 5ER)
◆ **Wednesday 8 November.** Bumpkins Restaurant (London SW7 3RD)
◆ **Wednesday 6 December.** Athenaeum (London SW1Y 5ER)

➤ Please contact Caroline Seymour on carolines@nubianconsulting.co.uk for more information and to make a reservation

| | 2017 £ | 2018 £ |
|---|---|---|
| Junior Candidate Fellow | 10.00 | 10.00 |
| Candidate Fellow | 15.00 | 15.00 |
| Candidate Fellow full course fee | 0.00 | 0.00 |
| 27 and under | 70.00 | 72.00 |
| 28-33 | 130.00 | 134.00 |
| 34-59 | 198.00 | 204.00 |
| 34-59 (Overseas) | 152.00 | 156.00 |
| 60-69 | 99.00 | 102.00 |
| 60-64 | 130.00 | 134.00 |
| 65-69 | 99.00 | 102.00 |
| 70+ | 68.00 | 70.00 |
| Honorary Fellow | 0.00 | 0.00 |
| Life Fellow | 0.00 | 0.00 |
| Senior Fellow | 0.00 | 0.00 |
| Concessions | 70.00 | 72.00 |
| Concessions (ERET) | 0.00 | 0.00 |
| Special Free Rate | 0.00 | 0.00 |
| Joint Fellow Non-Payer | 0.00 | 0.00 |
| Full time postgraduate MSc | 28.00 | 29.00 |
| Full time postgraduate PhD | 41.00 | 42.00 |
| RAS 25% discount | 148.00 | 153.00 |
| BP-funded postgraduate | 41.00 | 42.00 |
| Unemployed | 0.00 | 0.00 |
| Supplement (to payer) for Joint Fellowship | 58.00 | 60.00 |
| CGeol supplement payers | 48.00 | 49.00 |

# Mentoring Workshop

**Chartership Officer Bill Gaskarth announces a new Manchester-based mentoring workshop.**

The Society has run several successful mentoring workshops, the most recent being on 5 May at Burlington House. Another is scheduled for Manchester on 21 June, with a few places still available.

➤ To register, and for more information please go to: http://www.geolsoc.org.uk/GSL-Manchester-Mentoring-Workshop. Further enquiries, contact the Chartership Officer at E: Chartership@geolsoc.org.uk

# New specialist group

**The Society welcomes the formation of a new Specialist Group dedicated to the study of Contaminated Land, writes Dawne Riddle.**

The investigation and management of contaminated land is a multi-disciplinary science bringing together different geological specialisations (e.g. hydrogeology, engineering geology and geochemistry) together with other non-geological professionals (e.g. chemists, toxicologists, engineers). This puts geoscientists at the forefront of efforts to develop the conceptual site models that robust and defensible contaminated land risk assessments depend on, and makes the Geological Society the natural home for those specialising in this sector.

The Contaminated Land Group will hold meetings, conferences, seminars, webinars, training courses and workshops; represent and promoting the Geological Society and its science strategy in respect of land contamination issues; promote and support those seeking chartership (CGeol or CSci) as land contamination specialists, and promote and support those seeking to join the SiLC, RoGEP and SoBRA registers and taking part in the Land Forum backed 'National Quality Mark Scheme'.

# New strategy launched

**Serving science, profession and society: A strategy for the Geological Society, 2017-2027, is published, writes Malcolm Brown, President.**

Over the past year, Council has been discussing priorities for the coming decade, and has developed a new ten-year strategy for the Society, in consultation with staff, committees and (via our Specialist and Regional Groups) Fellows. You will find a summary version of the strategy enclosed with this issue of ***Geoscientist.*** At its heart is the interdependence of our science, our profession and the societal benefit they deliver.

➤ To read the full strategy and to get involved in putting it into practice, visit www.geolsoc.org.uk/strategy

# From the Publishing House

**Jenny Davey has the latest from the Geological Society Publishing House. Open Access articles from the Special Publications series available on the Lyell Collection.**

## Full Book Collection price held

*Isostasy as a tool to validate interpretations of regional geophysical datasets – application to the mid-Norwegian continental margin*, by Sofie Gradmann, Claudia Haase, and Jörg Ebbing. Isostasy is a well understood concept, yet rarely applied to its full capacity in regional interpretations of crustal structures. This study utlilises a recent density model for the entire NE Atlantic, based on refraction seismic data and gravity inversion, to calculate isostatically balanced bathymetry along the mid-Norwegian margin.

◆ **http://bit.ly/2oBPXln**

*Radioactive Waste Confinement: Clays in Natural and Engineered Barriers* – introduction by Simon Norris. There is general agreement internationally (Nuclear Energy Agency, OECD 2008) that geological disposal provides the safest long-term management solution for higher-activity radioactive waste. Many countries (e.g. Canada, Finland, France, Switzerland, Sweden, UK and USA) have chosen to dispose of all or part of their radioactive waste in facilities constructed at an appropriate depth in stable geological formations.

◆ **http://bit.ly/2nj0LnG**

## Recently in JGS

*A detrital record of the Nile River and its catchment*, by Laura Fielding, Yani Najman, Ian Millar, Peter Butterworth, Sergio Ando, Marta Padoan, Dan Barfod, and Ben Kneller
Journal of the Geological Society, v. 174:301-317, first published on December 7, 2016, doi:10.1144/jgs2016-075 OPEN ACCESS ARTICLE

This research uses analyses from Nile-catchment rivers, wadis, dunes and bedrocks to constrain the geological history of NE Africa and document influences on the composition of sediment reaching the Nile delta. The data show evolution of the North African crust, highlighting phases in the development of the Arabian–Nubian Shield and amalgamation of Gondwana in Neoproterozoic times.

◆ **http://bit.ly/2nCPcLt**

Sample information, analytical methods and data tables are available at:

◆ **http://bit.ly/2obye7P**

...in the Geological Society Figshare portal, which offers authors an improved discoverability and archiving service for data sets and other supporting material.

# CCS - solution or problem?

Carbon Capture and Storage (CCS) is decarbonisation's great white hope. **Ian Duncan MEP FGS*** visited Canada to learn more

The UN Paris Climate Change Treaty became law in September 2016 - committing the global community to arrest global temperature rise at 'well below' 2°C. But brokering the deal was the easy part - decarbonisation will be the devil. The globe is still wholly dependent upon carbon, even with progress in renewables and synthetic materials.

## Bitumen

Some 95% of Canada's remaining fossil fuel reserve is bitumen, extracted from the tar sands of Alberta. To date only 5% have been exploited. Bitumen recovery employs 130,000 Canadians, generates $5.5 billion per year and adds 2% to Canadian GDP. That's the upside. The downside: Alberta's bitumen extraction has resulted in annual carbon emissions of 70m tonnes (0.13% of global emissions). Were Alberta to exploit all its economically recoverable bitumen, some 22bn tonnes of carbon would enter the atmosphere and increase global temperatures by 0.4°C.

One of the world's largest CCS facilities - Shell's 'Quest' project - is in Alberta. It can capture (and sequester deep underground) a third of the $CO_2$ produced by the conversion of bitumen into 'lighter' oils in the Scotford installation - the equivalent of 1m tonnes of $CO_2$ every year. Over its 25-year lifespan, 25m tonnes of carbon will be captured: but 50m tonnes will not.

The governments of Alberta and Canada recognise that tar sand recovery sits uncomfortably alongside climate change ambition. So the Albertan government proposes to cap emissions at 100m tonnes per year and to tax the $CO_2$ released into the atmosphere at a rate of $30 (£18) per tonne. However since annual emissions from bitumen processing are 70m tonnes, this still allows significant growth in the industry – not much of a 'cap'.

## Emissions

CCS can substantially reduce emissions. But should such carbon abatement technology be deployed to allow the extraction of carbons and hydrocarbons - such as tar sands - which are known to be particularly polluting? Or should it be reserved for the mitigation of emissions from less polluting fossil fuels like natural gas?

Shell argue that Quest has been an important learning process; that the next generation will be more efficient. It is also clear that the Albertan and Canadian Governments are determined to exploit tar sands. That is why Canada invested $120m in Quest, and Alberta $745m. Were it not for Quest the atmospheric pollution would literally be stratospheric.

## Faustian

So, given this is happening, using CCS to cut emissions is 'a good thing'. But if the use of CCS encourages prolonging our dependence on bitumen or coal, resulting in the release of more carbon than is saved, many would argue that it is 'a bad thing'. Would this Faustian pact be more palatable if recovery efficiency was nearer 90% than 30%? Perhaps.

A nation with an economic reserve will seek to exploit it. However, if every nation does so, then the world will just go on warming. CCS could be part of the solution, or part of the problem. Having experienced the hottest year on record the challenge remains. We don't have much time to find out.

## REFERENCE

1. http://bit.ly/2k5bncA]

***Ian Duncan FGS** is Conservative MEP for Scotland and a member of the Committee on the Environment, Public Health and Food Safety.

## SOAPBOX CALLING!

Soapbox is open to contributions from all Fellows. You can always write a letter to the Editor, of course: but perhaps you feel you need more space?

If you can write it entertainingly in **500 words**, t the Editor would like to hear from you. Email your piece, and a self-portrait, to **ted.nield@geolsoc.org.uk.** Copy can only be accepted electronically. No diagrams, tables or other illustrations please.

Pictures should be of print quality – please take photographs on the largest setting on your camera, with a plain background.

Precedence will always be given to more topical contributions. Any one contributor may not appear more often than once per volume (once every 12 months).

> "A NATION WITH AN ECONOMIC RESERVE WILL SEEK TO EXPLOIT IT. HOWEVER, IF EVERY NATION DOES SO, THEN THE WORLD WILL JUST GO ON WARMING"
>
> IAN DUNCAN

# BLOWING
## HOT AND COLD

**Colin Summerhayes*** surveys our evolving ideas about climate change from 1750 to 1900

*Above: Our changing climate - how have scientists through the ages thought about shifts in global temperatures?*

It was a great surprise to early geologists that, since the end of the Cretaceous Period, planet Earth had cooled so much that an Ice Age could develop. One of the first to remark upon the cooling, in 1788, was naturalist Georges-Louis Leclerc, Comte de Buffon (1707-1788). Keeper of the *Jardin des Plantes*, Buffon realised that differences in climate might explain differences between living and fossil organisms found at the same place.

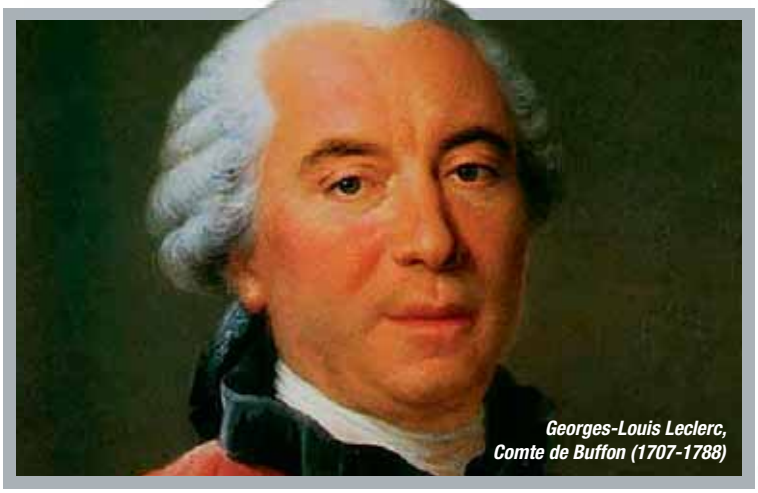
Finding, in Siberia and Europe, the fossil remains of animals from modern tropics, Buffon deduced that past northern climates were warmer. Thinking that the temperature of the air reflected the temperature of the Earth, he believed his fossil remains suggested that the Earth was cooling - from its original molten state; a notion dismissed, in 1824, by Joseph Fourier (1768-1830).

### Cuvier

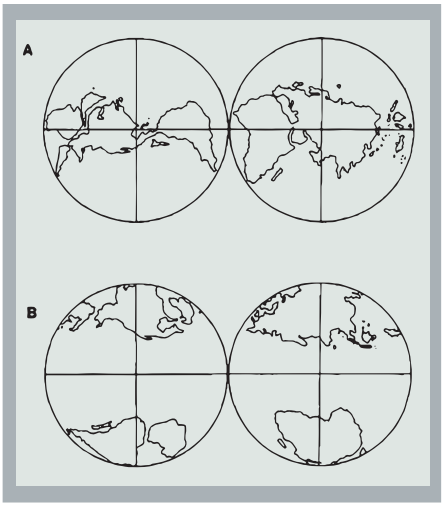
A later Professor at the *Jardin des Plantes*, Georges Cuvier (1769-1832), found Buffon's Siberian fossils of woolly rhinoceros and elephant to be the remains of extinct species, and identified the 'elephant' remains as mammoths. Knowing that mammoths were found frozen into the tundra, Cuvier attributed the freezing to an environmental catastrophe, consistent with his notion – contrary to the views of James Hutton (1726-1797) - that catastrophe played a key role in geological history. With that freezing we have the first inkling of the concept of an 'Ice Age'.

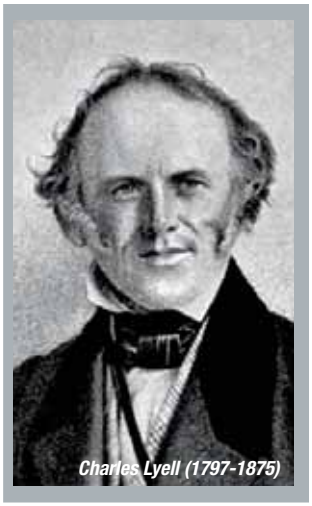
Cuvier's senior colleague Jean-Baptiste de Monet, Chevalier de la Marck, commonly known as Lamarck (1744-1829), challenged this call for catastrophic change. Studying the sequence of fossil molluscs from the region around Paris,

> LAVOISIER'S REPORT INFLUENCED ALEXANDRE BRONGNIART (1770-1847), NEWLY APPOINTED DIRECTOR OF THE PORCELAIN FACTORY AT SÈVRES, WHO WAS KEEN TO FIND NEW DEPOSITS OF CLAY NEAR THE CAPITAL.

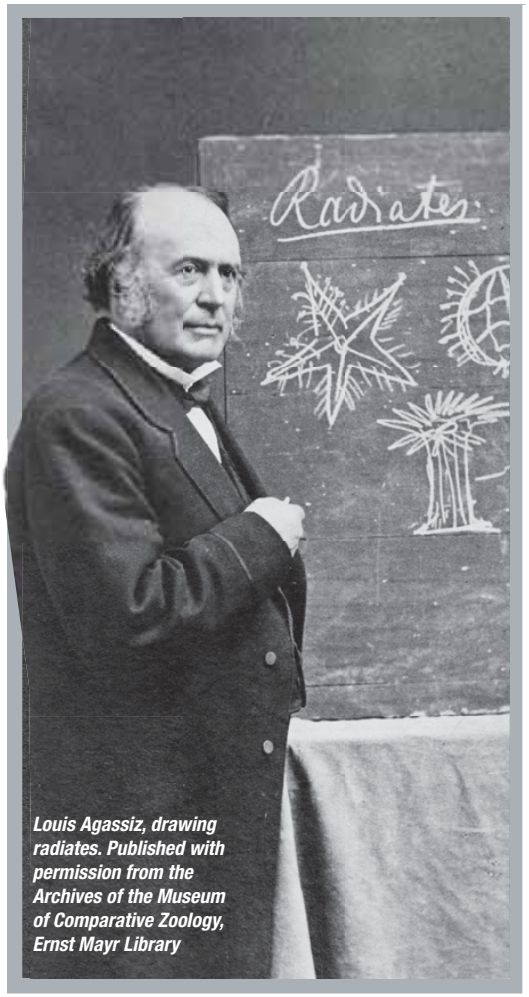


Georges-Louis Leclerc, Comte de Buffon (1707-1788)



Charles Lyell (1797-1875)




Louis Agassiz, drawing radiates. Published with permission from the Archives of the Museum of Comparative Zoology, Ernst Mayr Library

*Centre, Bottom: Extract from a lithograph of Charles Lyell from the Frontispiece to Bonney, T G, 1895, Charles Lyell and Modern Geology. In Roscoe, H E, (ed.), The Century Science Series. Macmillan, New York, 222 pp. http://bit.ly/2oG16BG*

*Left, Bottom: Lyell's Continental Displacement. From Lyell, C., 1875, Principles of Geology. 12th Ed., v.1, John Murray, London. Figs 14 (A) and 15 (B) p. 270; also Fig 1 in Summerhayes, 1990, Palaeoclimates. J Geol. Soc. 147, 315-320*

he concluded in 1802 that many of them belonged to presently tropical genera, and that the climate must since have cooled slowly with time.

His interpretation of geological history was consistent with that of chemist Antoine-Laurent Lavoisier (1743-1794), who by 1789 had seen, in the alternating deep-water and shallow water deposits of the Paris Basin, evidence for a succession of slow marine transgressions and regressions. His vision of how these packages of sediment were built up through time by the alternating rising and falling of sea level is like our modern understanding of sedimentary cycles and far ahead of his time.

## Early 1800s

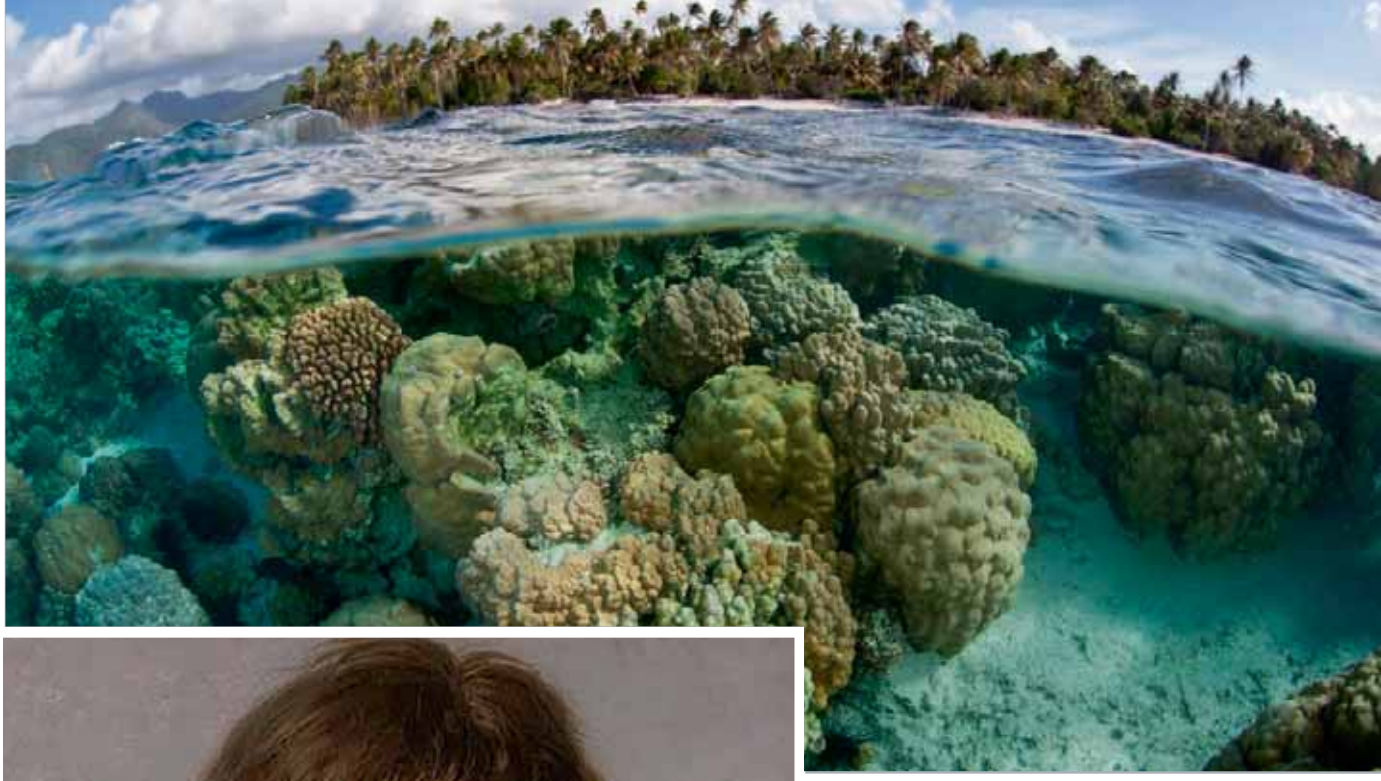
Lavoisier's report influenced Alexandre Brongniart (1770-1847), newly appointed Director of the porcelain factory at Sèvres, who was keen to find new deposits of clay near the capital. Visiting London in 1802 to find out more about the mass production of ceramics by the Wedgwood factory, he was made aware of the novel stratigraphic ideas of William Smith (1769-1839). Returning to France he persuaded Cuvier to work with him to apply Smith's techniques to map the Paris Basin, delivering their results in 1808 and 1811.

German geologist, botanist and polymath Baron Alexander von Humboldt (1769-1859) made expeditions that convinced him that Nature was holistic – its parts were intimately related and only understandable with reference to the whole: plants grew where they did in response to relationships between biology, meteorology, geography and geology. His analysis of the global distribution of temperatures demonstrated in 1817 that they followed 'isothermal lines' dividing the world into climatic zones.

## Lyell's Principles

This set the scene for Charles Lyell (1797-1875), the greatest geologist of his time. A great integrator, Lyell rose to fame with the publication of his *Principles of Geology* in three volumes between 1830 and 1833, and (from 1838) his *Elements of Geology*, a guide to the practice of the new science. Together these were the first comprehensive geological textbook.

The key to Lyell's approach lay in the subtitle to *Principles*, namely: *"An attempt to explain the former changes of the Earth's surface by causes now in operation"*, which demonstrates the influence of Hutton (*'the present is the key to the past'*). Unlike Cuvier, Lyell believed that what appeared from the geological record to ▶



*Coral reef distribution is strictly controlled by ocean temperature and varies widely through geological time according to the width of the tropical zones.*

*Baron Cuvier. From Anon (1833) Portrait of Baron Georges Cuvier. In The Gallery of Portraits: With Memoirs, vol. 2, C. Knight, London. Also at http://bit.ly/2nGGvj4*

*Constant Prévost 1787-1856*

*Alexandre Brongniart (1770-1847)*

be the results of catastrophic events arose instead by the steady action of processes observable today.

In 1823, Lyell met Cuvier, along with Brongniart and Brongniart's former student Constant Prévost (1787-1856), while visiting Paris to improve his French. He was impressed to find that young Prévost, unlike Cuvier, thought that the changes in strata in the Paris Basin came about gradually, not as the result of a series of catastrophic events.

A key influence on the *Principles* was Italian geologist Giovanni Battista Brocchi (1772-1826), curator of the museum of natural history in Milan. He in 1814 published a comprehensive study of the molluscan fossils and stratigraphy of Italy's sub-Appenine region - a study comparable to that of William Smith in England and Brongniart and Cuvier around Paris. Comparing modern and ancient molluscs, Brocchi noticed that the recent species from older Tertiary strata now inhabit warmer climates, suggesting, as Lamarck had deduced, that the world was cooling.

Taking note, Lyell became expert on fossil molluscs. By 1828 he had used the changing percentages of modern molluscs to subdivide the Tertiary Period into several geological epochs. Enlarging his studies with the help of other fossil mollusc experts (Gérard Deshayes (1795-1875) in France and Henrick Beck (1799-1863) in Denmark) he concluded that Europe's Eocene had had a 'tropical' climate, while Pliocene climate was more like today's, with the Miocene lying in between. In volume two of the *Principles* he observed: "a great body of evidence, derived from independent sources, that the general temperature

has been cooling down during the epochs which immediately preceded our own" - an observation later confirmed by palaeobotany.

Lyell devoted three chapters in *Principles* (volume 1) to showing how past climates could be recognised from types and distributions of sedimentary rocks and fossils. He also incorporated seven chapters on 'Aqueous Causes', under which he listed rivers, torrents, springs, currents, tides and icebergs as agents, all of them changing with climate. He agreed with Buffon, Cuvier, Lamarck and Brocchi that Europe's climate had been much warmer in former times, but found no need to explain the cooling by catastrophe (Cuvier) nor by the cooling of the planet itself (Buffon).

Lyell was much influenced by Humboldt, whom he met in Paris in 1823, and in Potsdam in1850, immediately realising the geological significance of his 'isothermal lines'. If Europe's older rocks had been deposited in much warmer climates than today's, and if the Earth's climate zones had not changed, then Europe must have moved across them. Geography had changed with time. Writing excitedly to Gideon Mantell (1790-1852) in February 1830, and swearing him to secrecy, he said: "I will give you a receipt ['recipe'] for growing tree ferns at the pole, or if it suits me, pines at the equator; walruses under the line [the Equator], and crocodiles in the arctic circle." [18]. This idea profoundly changed the way people thought about climate change.

Lyell's thinking on geographical control of climate matured as he gathered more data – especially during visits to North America in the 1840s. In the 12th edition of the *Principles*, anticipating Alfred Wegener's continental drift, he observed: "If we go back … to the Eocene period…we find such a mixture of forms now having their nearest living allies in the most distant parts of the globe, that we cannot doubt that the distribution of land and sea bore scarcely any resemblance to that now established."

He was well aware of how geography (the positions of continents, coasts and topography) modified climatic zones, observing: "…on these geographical conditions the temperature of the atmosphere and of the ocean in any given region and at any given period must mainly depend…". Moving continents around was dramatic stuff, though Lyell had no other information than his climate theory to back him up. The rest would have to await Wegener.

## Ice Age controversy

Lyell was also aware that ice could move and behave as a geological agent. Not only had he seen mountain glaciers transporting rock debris to be dumped in moraines, but also he knew that polar mariners had seen drifting icebergs transporting large amounts of rock. That led him to speculate that melting icebergs would dump their loads on the seabed to "…offer perplexing problems to future geologists".

In Volume 3 of the first edition of *Principles* he speculated that the erratic blocks littering the landscape away from glacial valleys in the Alps and the Jura had been transported by floating ice (not by ice sliding over land as some Swiss geologists thought). At that time Lyell did not link the erratic blocks of Switzerland to those of northern Germany or Britain. However, his notion that erratic blocks of alien geology might have been deposited naturally by icebergs was a blow to the early 19th Century theory, embraced by - among others - Lyell's old Oxford tutor, William Buckland (1784-1856), that such blocks were the relics of Noah's flood.

Before long Lyell's iceberg hypothesis embroiled him in a climate controversy that was to last for most of the 45 years between the first and last publication of *Principles*. It began with the pronouncement, in 1837 by Swiss geologist Jean Louis Rodolphe Agassiz (1807-1873), that a vast ice sheet must have carried erratic blocks across Europe in a recent Ice Age.

Although Lyell had recognised the great cooling through the Tertiary to the present, and that recent times had been cold enough to freeze mammoths whole, he had not realised that its most recent manifestation had frozen the northern regions. Nothing was known at that time of the geological history of the Antarctic. Agassiz had learned from Jean de Charpentier (1786-1855), Director of Mines of Switzerland's Canton de Vaud, that Swiss glaciers had formerly been much more extensive. Knowing, in addition, that erratic blocks were common across northern Europe, Agassiz had made a giant intellectual leap, concluding that a great ice sheet had "covered the surface of the earth with

***Above:** William Buckland 1784-1856*
***Below:** Ice Transporting Rocks at Sea, Erebus & Terror Gulf, West Antarctica. Photo: Colin Summerhayes*

"MOVING CONTINENTS AROUND WAS DRAMATIC STUFF, THOUGH LYELL HAD NO OTHER INFORMATION THAN HIS CLIMATE THEORY TO BACK HIM UP. THE REST WOULD HAVE TO AWAIT WEGENER."

▶ a sheet of ice, extending at least from the north pole to Central Europe and Asia". This drew much astonishment and ridicule, and Humboldt counselled Agassiz to abandon his icy speculations.

Very few Europeans knew anything about ice sheets. Little was known about Greenland, and the vast extent of the Antarctic ice sheet was not appreciated until after James Clark Ross (1800-1862) had published (in 1847) the results of his visits to the Ross Sea with *HMS Erebus* and *HMS Terror* in 1841 and 1842. Even so, Agassiz had leapt ahead of himself by claiming that ice extended as far as the Mediterranean, when, as we now know, glacial erratic blocks were actually confined to the Alps and northernmost Europe. Agassiz's Ice Age hypothesis was fully developed in his 1840 book *Etudes sur les Glaciers*, and further expanded to include North America after his discovery of evidence for a former ice sheet there following a visit to Boston in 1846.

## Buckland

By 1840, Agassiz had convinced William Buckland that there had indeed been an Ice Age in recent times and that northern Britain carried evidence of the passage of a vast ice sheet. Buckland even managed to convince Lyell that the piles of rocks near Lyell's Scottish home were probably moraines. Nevertheless, their combined lectures to the Geological Society, in November and December 1840, failed to convince their audience, leading Buckland to concluded the session by condemning to "the pains of eternal itch without the privilege of scratching" anyone challenging ice age theory.

Part of the problem was that Roderick Murchison (1792-1871), who had visited Scotland with Agassiz and Buckland, remained unconvinced. Murchison had been President of the Geological Society of London from 1831-33, and was again from 1841-43. During his Presidential Address in the latter term, he attacked Ice Age theory, not recanting until 1862, in a further address. Sending a copy of this 1862 paper to Agassiz he wrote: "I have the sincerest pleasure in avowing that I was wrong in opposing as I did your grand and original idea of my native mountains. Yes! I am now convinced that glaciers did descend from the mountains to the plains as they do now in Greenland". Evidence had mounted up, due in no small part to the assiduous research of Archibald Geikie (1835-1924), who was to publish a seminal paper on the glacial deposits of Scotland in 1863, and of which Murchison was aware.

Lyell remained unconvinced, certain that the gouges in Scottish rocks that Geikie attributed to stones embedded in an ice sheet were carved by stones embedded in icebergs. Having seen moraines in the Alps, he was not going to deny the role of mountain glaciers in transporting erratic blocks; but he thought that icebergs had done the work beyond the mountains, depositing what he called 'glacial drift', including boulder clay, or what he termed 'till'. We unwittingly inherit this thinking in using the term 'drift' today. Lyell's 'drift' replaced what had been termed *'diluvium'*, following Buckland's idea that these were deposits from Noah's flood. Terminology reflects history.

Lyell seems not to have realised that periodically covering the UK (and indeed adjacent Europe) with an iceberg-studded sea several hundreds of feet deep would require either rather sudden changes in sea level or, conversely, sudden changes in land level, for neither of which was there any evidence, nor indeed any plausible mechanism. One might consider these suppositions as infractions of his otherwise uniformitarian approach!

*Archibald Geikie 1835-1924*

*Joseph Fourier 1768-1830*

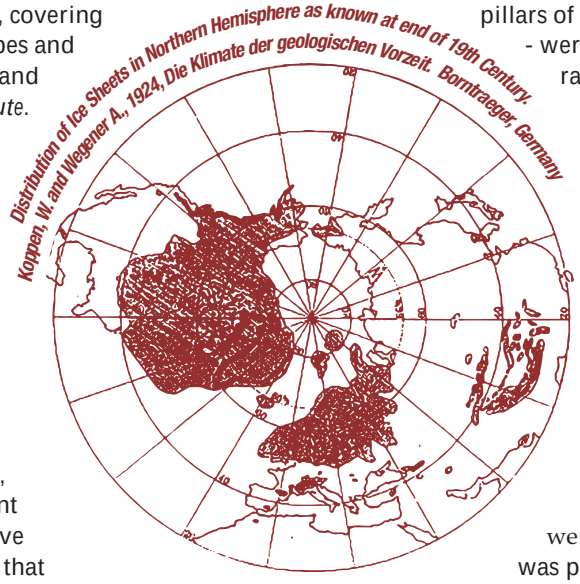


*James Geikie 1839-1915 by M I Newbigin and J S Fett, Photo from Project Gutenberg e-book*

## Vision

The contrast between Lyell and Agassiz was one of vision. Lyell stuck to hard evidence. He thought he knew what glaciers and icebergs could do, but his knowledge was limited. Agassiz could envision a merging of mountain glaciers into a great sheet of ice that he called "God's Great Plough", covering entire landscapes and dumping clay and boulders *en route*. While Lyell eventually accepted that smoothed and polished rocky surfaces in and around Switzerland and Scotland were formed by an ice sheet, he was adamant that it must have been local and that what lay beyond was due to icebergs broken from local ice sheets.

The final nails in the coffin of his iceberg theory came just as the 12th and final edition of *Principles* was going to press. In 1874 James Geikie (1839-1915), Archibald's younger brother, published a definitive study of glacial geology - *The Great Ice Age*, clearly demonstrating the role of ice sheets - and in 1875 James Croll (1821-1890) reported that icebergs carrying stones – one of the pillars of Lyell's theory - were exceedingly rare. (Even so, while bergs with stones on the surface may be rare, that does not mean that they do not have stones embedded in their largely invisible bases.)




Nowadays we know that Lyell was partly right. Ice Age iceberg drift does explain the occurrence of blocks of granite and related continental rocks dredged from the Mid-Atlantic Ridge in the northern North Atlantic, and the African continental shelf south of Cape Town. And as Bill Ruddiman showed in 1977, ice-rafted sediment dropped by icebergs derived from the Laurentide ice sheet covers much of the floor of the North Atlantic. On a Marion Dufresne cruise in 1995 I even found some of it in a core on the Portuguese margin off faraway Lisbon. In 1988 Hartmut Heinrich showed that these deposits were cyclic – we now call them Heinrich Events, each reflecting a surge in the Canadian ice sheet. Wedded as he was to icebergs, I am sure Lyell would have been excited to see that the science always moves on.◆

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## FURTHER READING

This feature is a distillation of Chapter 2 of Summerhayes, C P, 2015: **'Earth's Climate Evolution' Wiley, Chichester.** The references quoted in the text may be found in the Further reading list available with the Online version of this article.

*Baron Alexander von Humboldt in a mountain grotto working on his botanical specimens, by Friedrich Georg Weitsch (1758-1828). From McCrory, D., 2010, Nature's Interpreter – The Life and Times of Alexander von Humboldt. Lutterworth Press, 242pp (p71)*

*James Hutton: Portrait by Sir Henry Raeburn (1756 - 1823) Scottish National Portrait Gallery*

# GIRLS INTO GEOSCIENCE

> “WE DIDN’T KNOW OF ANY WHO WERE SPECIFICALLY TARGETING EARTH SCIENCES AT THE GRASS ROOTS LEVEL. SO, OVER COFFEE THREE AND A HALF YEARS AGO, ‘GIRLS INTO GEOSCIENCE’ WAS BORN”

# **Sarah Boulton and Jodie Fisher*** on their three year-old initiative to increase geoscience participation among females

"My teacher told me that geology is not for girls". No, not a comment from the 1950s but a recent statement from a potential undergraduate student attending a university open day. Surely young women's aspirations are not still being squashed like this in the 21st Century? Well, it appears they are. But are we surprised that such attitudes persist, when the overall STEM workforce in the UK consists of only 14.4% women[1]? Or when physical sciences at university still attract <40% females[2]?

## A day to inspire

This got us thinking - what could we do? There are a number of excellent women in STEM initiatives; however, we didn't know of any who were specifically targeting Earth sciences at the grass roots level. So, over coffee three and a half years ago, *'Girls into Geoscience'* was born. We wanted to design a day to inspire and educate, as well as create a positive image of geoscience for women. Incorporating career aspirations and hands-on geology, we wanted to raise awareness and to encourage more females to take geoscience courses at university, by showing what is possible with a geosciences degree - and of course to show that 'geology is not just for boys'!

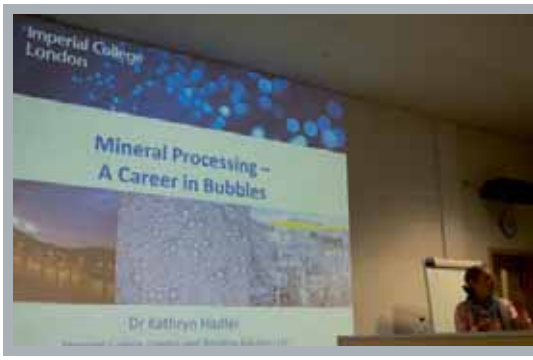
Our *Girls into Geoscience* day is primarily aimed at Year 12 female students who are thinking about applying for university. We welcome all students interested in geoscience, whether they have studied geology, have some geological knowledge, or are completely new to the subject. Not limited to local schools and students, we also welcome a large number of individual students who have travelled long distances, as well as school groups (local and not so local) with accompanying teachers (see map). We hope to engage the teachers as much as students, as they are the ones who are in a position to inspire the next generation. We want teachers to learn new geological skills and refresh their knowledge, as well as to take back our message into their schools and spread the geological word.

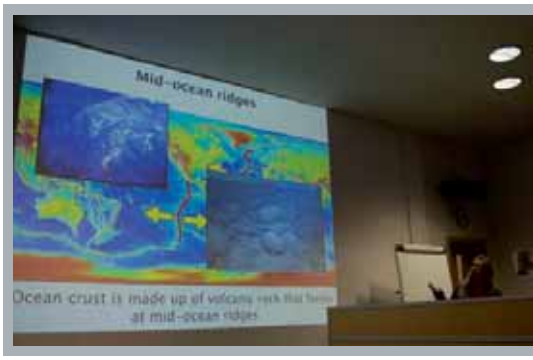
June 2014 saw the first *Girls into Geoscience* day, with 65 girls and five teachers attending. The morning session consisted of a diverse range of talks on petroleum geology, engineering geology, academia and life aboard an Integrated Ocean Drilling Program (IODP) drilling ship. The aim of these talks is to showcase a range of career pathways, and we endeavour to invite early-career female geoscientists from industry and academia, as well as more experienced scientists. Girls are able to network with the speakers over lunch, as well as to talk to staff and current female students studying Earth sciences at Plymouth University. Campus tours are also offered to anyone interested in seeing more of the university facilities, and our specialist Earth science laboratories.

## Workshops

In the afternoon, an insight into the university experience is given through hands-on workshops run by female PhD students, postdoctoral researchers and academic staff. Four workshops are offered on a range of topics from applied volcanology and hazards, to subsurface geology. Students may participate in any two of four available workshops. The attendees really appreciate this option to focus on their interests, and it is all part of our ethos to run the day in the style of an academic conference.

The success of this event led to a second in 2015, and a third in 2016. In 2016 we wanted to offer an even fuller geological experience, and so decided to offer a field trip, to demonstrate that there are no barriers to female inclusion in the field - something previous attendees had requested. Utilising Plymouth's amazing local geology, we ran the excursion to Dartmoor National Park on Sunday 3 July 2016. We introduced students to field observation, description, and recording of geological materials and contacts. Accessible for those who had done fieldwork before, as well as those who hadn't, we ensured each student was able to learn some new skills and get to grips with geology in the field. We were lucky ▶


***Top:** Geographic spread of participants*
***Below:** Illustrations from science and careers events. See text for details.*


*Models from a micropalaeontology practical*

▶ with fantastic weather at both locations (Great Staple Tor and Burrator Quarry), with 30 students and two teachers attending.

The excursion was followed on Monday by morning talks and afternoon workshops, as in previous years, with 80 students and 11 teachers attending. The morning talks gave a fascinating insight to real geological careers, with talks from Claire Jennings (Aquageo) on marine geology and seismic acquisition, Dr Kathryn Hadler (Grinding Solutions/ Imperial College London) on mining and mineral processing and Dr Michelle Harris (Plymouth University) on hydrothermal systems and ocean drilling.

## Meteorite

Following lunch and the university tours, the afternoon workshops included a chance to examine meteorites in hand specimen, and thin sections of martian, lunar and asteroidal rocks; to get to grips with geological time; understand how microfossils can be used to interpret past climate change; and to investigate the surface rupture of the 2010 Darfield Earthquake (New Zealand) using GoogleEarth.

This year we also offered school groups the opportunity to stay overnight in hall. This was a help to those coming from further afield, but it also allowed potential students see student accommodation first-hand, and gave them a fuller impression of the university experience.

We have been able to reflect on each event with the help of feedback from students and teacher attendees. Feedback is the key to monitoring the impact of the *Girls into Geoscience* programme, and to adapting the event to students' desires and expectations. This year for the first time we will also be following attendees through their university application process, to monitor if, and how, attending *Girls into Geoscience* may have shaped ideas about geoscience, and studying it at university.

A Plymouth we currently have two enrolled students who attended the 2014 event, as well as eight further applicants to geology and geography degrees. From the 2015 event we have received four applications (and two acceptances), and we hope to welcome more from among the 2016 cohort. This year's feedback showed that all the students enjoyed the day; 75% said they would be more likely to consider doing geology as a degree as a result (only 16% said they weren't going to consider geology, and the other 9% had already wanted to do geology), while 54% said they would be more likely to consider studying Geology at Plymouth University.

## Free

We offer this two-day workshop free of charge, through the generous support of the School of Geography, Earth and Environmental Sciences, and the University of Plymouth central outreach team. We have also been lucky to receive some sponsorship and funding from BP, the Micropalaeontological Society and the Royal Astronomical Society.

We hope to continue running this event for many years to come and with the next date set for 2-3 July 2017 (again featuring a day in the field and a programme of talks and workshops) we look forward to welcoming more girls to find out about the geosciences.

*Girls into Geoscience* is becoming more than just an event. It has become a network, supporting women in geology and those aspiring to be. Get involved!

## Find out more

To promote the event and our aims we have set up a very active twitter account (@girlsingeosci) and a blog (https://girlsintogeoscience.wordpress.com/) promoting geoscience to girls and profiling women in geoscience who are willing to share their stories and give advice on how they achieved their career goals. See also https://www.plymouth.ac.uk/whats-on/girls-into-geoscience. ◆

➤ To the whole *Girls into Geoscience* team without whom this day would not be possible. To Plymouth University for their support, and to The Micropalaeontological Society and the Royal Astronomical Society for their sponsorship of our workshops. Finally, to all of our speakers over the last three years for giving their time and expertise to our event

## REFERENCES

1. **Labour Force Survey April-June 2015,** published by Office for National Statistics, August 2015. http://bit.ly/2e8YTN8 [accessed 17/08/16]
2. **Equality change unit, 2015.** http://www.ecu.ac.uk/ [accessed 17/08/16]

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# READERS' LETTERS

**Geoscientist** welcomes readers' letters. These are published as promptly as possible in Geoscientist Online and a selection printed each month. Please submit your letter (300 words or fewer, by email only please) to **ted.nield@geolsoc.org.uk**. Letters will be edited. For references cited in these letters, please see the full versions at **www.geolsoc.org.uk/letters**

## Code buried


*Sir,* Martin Shepley's *Soapbox (Geoscientist 27.02 March 2017)* raises some interesting points. I searched on our website for 'ethics' and found nothing. By diligence I found our Code of Conduct, but not by following any obvious link and it was not found anywhere near the top of the list by the search engine; but at least this alerted me to its title. The Code is binding on all Fellows, not just CGeols.

I wrote to Professor David Manning when he was President, drawing attention to this difficulty, and also to the lack of real guidance on how to deal with certain ethical issues. (I no longer have his reply to hand, but it was along the lines of 'noted, but not high priority'.)

We are in exactly the same position in 2017 – the Code remains buried, and there is no useful guidance on how to tackle unreasonable requests to disguise scientific truth or even to ignore illegal acts. I still find myself in ethically uncomfortable places, even as recently as this week.

Shepley also discusses the need not to stray from one's area of expertise - which the Code also stresses. But how is one's area of expertise proved? My formal qualification in hydrogeology is a PhD. This means that I was supervised rather than taught, and did not have to demonstrate to my examiners a grasp of all areas of hydrogeology to be awarded my degree in 1981. It was actually about inorganic hydrochemistry. I was able to demonstrate a wider grasp of hydrogeology when I applied for my CGeol in 1993. I learned about groundwater modelling (which is the capacity in which I worked with Martin Shepley) 'on the job'. Nowadays I do radioactively contaminated land, also worked out on the job. No-one offers a formal qualification in this, although I teach about it.

I can see the point in having a formal approval system for certain limited areas, but I am wary of trying to approve everything formally. The scope of geological expertise is too great. In any event, a formal qualification means only that you passed the exam, not that you have a thorough understanding of the topic.

No amount of formal framework will eliminate the possibility of fraud, which appears to be what Bre-X was about, or errors resulting from unknown unknowns, i.e. a professional being unaware of his ignorance of a topic. UK statute law already covers fraud, although professional ignorance involves the grey area of civil law. To what extent is ignorance negligence?

In the era of 'post truth' and also of more litigation, can we please have an accessible Code of Conduct and some guidance on its use?

**JOHN HEATHCOTE MA PHD FGS CGEOL**

CAN'T FIND YOUR MEETING? VISIT WWW.GEOLSOC.ORG.UK/LISTINGS FULL, ACCURATE, UP-TO-DATE

## ENDORSED TRAINING/CPD

| COURSE | DATE | VENUE AND DETAILS |
|---|---|---|
| Geology of the Lakes: An Introduction | 5-7 May | **Venue:** Higham Hall College, Bassenthwaite Lake, Cockermouth, Cumbria. **Contact E:** admin@highamhall.com **T:** 017687 76276. Fees apply. See website for details and registration. |

## DIARY OF MEETINGS 2016/2017

PLEASE NOTE THAT THERE ARE MANY MORE MEETINGS FOR WHICH WE DO NOT HAVE SPACE. ALWAYS CHECK WITH **WWW.GEOLSOC.ORG.UK/LISTINGS**

| COURSE | DATE | VENUE AND DETAILS |
|---|---|---|
| ESIOS Project<br>Southern Wales Regional | 2 May | **Venue:** LT 1.40 Cardiff University, Main Building, CF10 3AT. **Speaker:** Dr Geoff Baxter (BGS). **Time:** 1730 for 1800. Close 1900. **Contact** Simon Hughes **E:** swales.rg@geolsoc.org.uk |
| National Schools Geology Challenge & Early Career Geologist Award: 2017 Final<br>Geological Society | 3 May | Competition and Lecture.<br>**Venue:** Burlington House. See website for details. |
| GSL Mentoring Workshop | 5 May | **Venue:** Burlington House. Delivered by: John Arthurs. Rates apply. See website for details and registration. |
| Oil & Gas in SE England<br>South East Regional | 9 May | **Venue:** The Bell Inn, Godstone, Surrey. **Speaker:** Dr Chris Johns. **Contact** Sarah Cooke **E:** sarahcook@rocketmail.com |
| Rock Slope Engineering on A1 Widening Scheme, Tyneside Engineering Group | 17 May | **Venue:** Burlington House. **Speaker:** Athena Livesay. Time: 1730 for 1800. Contact Ursula Lawrence E: ursula.lawrence@capita.co.uk |
| Geothermal - The energy of the future<br>European Federation of Geologists; Association of Greek Geologists; UN Economic Commission for Europe | 18-19 May | **Venue:** Santorini, Greece. See website for details and registration. No contact. |
| Student Symposium:<br>Geology and societal change | 19 May | **Venue:** Burlington House. See website for details and registrations. Fees apply. **Contact E:** gass@geologistsassociation.org.uk |

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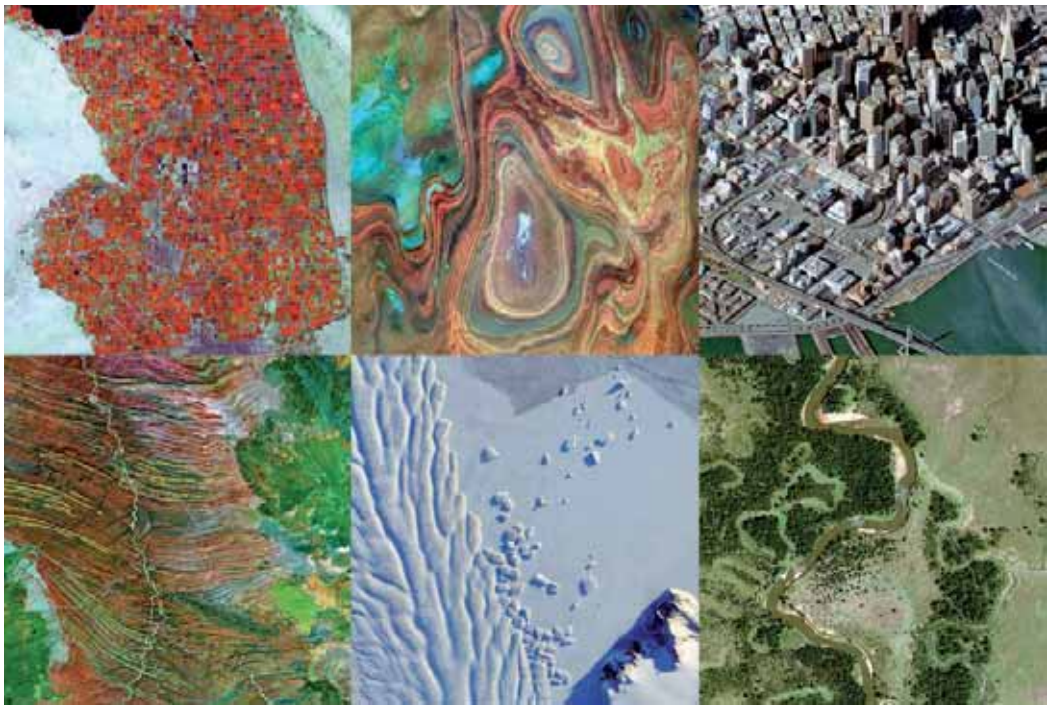



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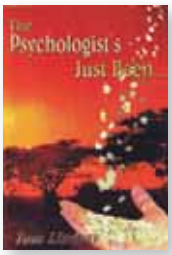
## The Psychologist's Just Been



It is unusual to find a title of this type in a book review section of a geological magazine. However, the essence of the book is essentially a semi-autobiography of a mineral exploration geologist.

The book does not even attempt to discuss the psychology of the field geologist's mind, which is probably a good thing! It does, however, give an excellent insight into the life of a field geologist over a period of almost 40 years. Each chapter is essentially an anecdotal story that indirectly maps the author's career and it makes a fascinating and interesting read. Because each chapter focuses on a different aspect of his career, it is an easy book to dip into from time to time without losing track of the overall story.

The author's search for diamonds and gold has taken place predominantly in Africa, Australia and China. Often set in remote and isolated wilderness, attempts to interpret the local geology in the search for minerals frequently become secondary to avoiding snakes and explaining to the local cook that macaroni cheese is not usually served as a frozen dessert.

Even when not working in the wilderness, the author is to be found crawling around one of the deepest gold mines in the world in a setting that would drive most modern health and safety officers to distraction, or dealing with extraordinary levels of bureaucracy in communist China. The anecdotes are witty and enlightening, giving the reader a fascinating insight into the career of a mineral exploration geologist.

One of the most interesting things to emerge is that the author's career has taken him to locations far from well-trodden tourist trails and during periods of significant social change. Scenarios and situations throughout the book are recorded with insight and wit and the author is always sensitive and respectful of all the cultures and traditions he encounters. It is, in fact, a valuable record of social and political change throughout this period.

The book does tend to jump from continent to continent rather abruptly; but once the reader gets used to this style of writing, it is an excellent read and one that can also be recommended to those without any knowledge of or expertise in geology.

However, if you are hoping for an in-depth psychological analysis of the mind of such a geologist, you should maybe head for a different section of the library.

Reviewed by: ***Tim Tubby***

**THE PSYCHOLOGIST'S JUST BEEN**
by TOM LINDSAY. 2015 Mirador Publishing.
210pp, Pbk. ISBN-10: 1911044427
ISBN-13: 978-1911044420.
**List Price: £8.99 Kindle edition £3.99**

## Chemical, Physical and Temporal Evolution of Magmatic Systems

Field observations and pioneering high-temperature experiments undertaken a century ago by Norman L Bowen founded the basis of modern igneous petrology. Bowen's work concluded that the chemical differentiation of magmas was primarily controlled by the settling-out of crystals from molten rock in magma chambers and the squeezing out of residual liquid.

This crucial initial insight into the chemical and temporal evolution of magmatic systems informed and underpinned subsequent research on igneous differentiation: magma chambers behave as crystal-poor 'boiling vats' in the crust where crystals, bubbles and melt separate gravitationally, heat dissipated to their surroundings initiating crystallisation, driving igneous differentiation.

Since 1915, research advances in the physico-chemical properties of sub-volcanic magmatic systems coupled with rapid technological development have fundamentally revised our understanding of this simple model. Igneous petrologists now recognise this paradigm is rare with most natural magmatic systems primarily existing in partially molten ('mushy') states, as serially arranged and variably interconnected storage regions, periodically replenished by different fluxes of magma and heat. Complex interplay in these fluxes and variations in physico-chemical properties as they rise through and navigate the crustal system, provide the dominant controls on magmatic differentiation and the eventual igneous materials produced.

This volume presents the modern understanding of the chemical, physical and thermal evolution of crustal magmatic/volcanic systems derived from recent research advances in igneous/metamorphic petrology, geochemistry, geochronology and numerical/thermal modelling. Introduced with a contextual overview paper, the volume contains 10 recent contributions organised into four fully-indexed thematic sections: 1: magma fluxes and phase equilibria, 2: phase equilibria, physical properties of magma and melt extraction, 3: architecture of subvolcanic reservoirs and 4: volcanic conduits.

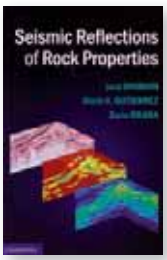
A thorough review of contemporary developments within this field, the anticipated readership is expected to be from postgraduate researchers and professional academic geoscientists specialising in igneous petrology and petrogenesis, geochemistry and allied disciplines. All contributions are well-written and edited, with clear and appropriate figures, photographs and data-tables, augmented with a spectacular cover photograph as a bonus!

In summary, the inherent complexities of the evolving perspective of magmatic systems reveal an account of 'mushmatism' more than magmatism. A fascinating and recommended read.

Reviewed by ***Mark Griffin***

**CHEMICAL, PHYSICAL AND TEMPORAL EVOLUTION OF MAGMATIC SYSTEMS**
by CARICCHI L and BLUNDY, J D (editors).
Geological Society of London Special Publication No 422. 2015. Geological Society of London.
ISBN 978-1-86239-732-3. Hbk. 223pp.
ISSN 0305-8719.
**List Price: £100.00 www.geolsoc.org.uk**

## Seismic Reflections of Rock Properties




This book provides a comprehensive and accessible guide to the application of rock physics for seismic analysis and interpretation to aid in the search for hydrocarbon reservoirs in oil and gas prospecting. It starts by introducing the reader to the basics of rock physics-based forward modelling before moving on to more advanced topics such as practical approaches to

frontier exploration, advance rock physics applications and computational rock physics (an evolving technique).

The book is 324 pages long with seven main sections broken into 19 chapters overall. It is beautifully prepared and well-illustrated throughout.
Dvorkin, Gutierrez and Grana initially discuss the rock-physics-based forward modelling approach following three basic steps:

- Varying rock properties systematically (such as lithology, porosity, rock type, pore fluids, reservoir geometry etc.) to generate synthetic seismic traces;
- Comparing these synthetic seismic traces to actual seismic traces from a wide database of field examples;
- Drawing conclusions based on the idea that similar seismic traces are generated by similar physical rock properties in the sub-surface, which allows the inference of rock properties from actual seismic traces.

The overall outcome of this method is to generate an accurate geological and geotechnical model ('pseudo-wells') of the subsurface. Various case studies based on real well data along with sample synthetic seismic reflections (such as silicilastic and carbonate rocks) from key realistic reservoir models provide a helpful reference catalogue for the reader.

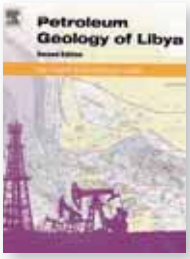
This small hardback book is logically laid out and includes an extensive set of references, highlighting how well published the authors are on the subject of rock physics - particularly Jack Dvorkin! Numerous figures are presented throughout the text and help illustrate the highly technical subject; however the graphs are typically presented on a small scale due to the A5 dimensions of the book and some finer details maybe lost. A nice surprise was the inclusion of the direct hydrocarbon indicator checklist within the appendix, as this provides a useful reference for practical application by the reader.

The book is well written and reasonably priced (particularly the kindle version). It provides more of a reference volume than 'light reading' for a non-specialist and as such I would recommend the book to experienced petroleum geoscience professionals.

Reviewed by ***Caroline Mason***

**SEISMIC REFLECTIONS OF ROCK PROPERTIES**
by JACK DVORKIN, MARIO A. GUTIERREZ and DARIO GRANA, 2014. Published by Cambridge University Press, 324pp ISBN 978-0-521-89919-2 Hardback
**List Price £51.00**

# Petroleum Geology of Libya




The first edition of this book was written by Don Hallett and published by Elsevier in 2002, at a time when diplomatic relations between Libya and the west were improving rapidly and a settlement was reached over Lockerbie. Tripoli was a good posting and numerous conferences and fieldtrips made that edition a must-have travelling companion.

Personally I worked in and out of Binghazi until 2010 but lost touch with the exploration community at the start of the civil war. The decade leading up to it saw significant advances in our knowledge of the four onshore basins and the offshore giants such as Bouri.

Hallett and Clarke-Lowes form the 'dream-team' in terms of regional knowledge and have continued to function at the forefront of geoscience in Libya, with access to new data, significant advances in exploration concepts and the interpretive gains in subjects such as sedimentology, sequence stratigraphy, palaeogeography, tectonics, and modelling.

The new edition has 347 colour figures, produced in the pastel shades successfully adopted by Nubian Consultancy. This edition is divided into eight chapters and a labour-saving bibliography lists over 1200 technical papers. The History of Oil and Gas Exploration (Chapter 1) is most informative and an essential read for the next generation of regional explorationists, setting a very high standard for the rest of the book.

Although the first Italian settlers and geologists were not welcome in pre-war Libya, the geologists led by Ardito Desio, Director of the Libyan Geological Survey 1936-1940, was first class, with Desio predicting that the Sirt Basin could be an oil province. The first chapter also documents the events of successive decades from 1950 to 2015, detailing a host of concessions and licences with informative notes on the complex nature of Libyan names, well-nomenclature and given field.

Chapter 2 is an excellent account of the plate-tectonic history of Africa, with the emphasis on North Africa and Tethys. It is beautifully illustrated and an essential lead-in to sections on Stratigraphy (3), Structure (4), Petroleum Geochemistry (5), Petroleum Systems (6), the Oil and Gas Fields of Libya (7) and Future Exploration and Exploitation Potential (8).

As before, these chapters are packed with detailed maps and cross-sections they are most pleasant to the eye and worth a fortune in terms information. It is a masterpiece. All explorationists should have a copy.

Reviewed by: ***Dick Moody***

**PETROLEUM GEOLOGY OF LIBYA: SECOND EDITION**
by DON HALLETT AND DANIEL CLARK-LOWES, 2016. Published by: Elsevier, 404pp (Sbk) ISBN 978-0-444-63517-4. eBook ISBN: 9780444635198
**List Price: US$252.00 (bundle), Separately US$210.00**

# Mountain - Nature and Culture


This book, a volume in the Earth Series commenced in 2012 by Reaktion Books, takes a fascinating look at natural phenomena from some rather interesting angles. These are not textbooks as such on floods, waterfalls, deserts, earthquakes, volcanoes and more besides, but beautifully produced volumes, copiously illustrated and crammed full of the most interesting and thought-provoking facts and observations.

Having read and thoroughly enjoyed the volume *Caves - Nature and Culture*, I greatly looked forward to immersing myself in a companion volume about mountains. Like many geoscientists and physical geographers I came into geology through an interest in the great outdoors as a walker and climber, and experienced wilderness country and its physical and spiritual impact early on in my career.

We should all, then, know exactly what a mountain is, shouldn't we? Well, all is not as it seems in the definition department and the contradictions and perceptions plunge us right into the subject from the first page. What follows, according to the author, is a book presenting mountains in the light of "… the holy and the diabolical, life and ▶

death, vision and time, science, technology and heritage".

Given the breadth of subject matter, the diversity of themes and the very wide factual spread for the author to draw on, you might be forgiven for thinking the subject is far too vast to cram into 264 pages. But you would be wrong, for the author has produced a fascinating exploration of the impact of those, often colossal, crustal features we call mountains.

Both real and imaginary, they have influenced human emotions, religious beliefs, scientific investigation and cultural responses; challenged human imagination and physical endurance and stimulated significant geological endeavour. Here is a wonderful collage of facts and stories, skilfully and cleverly structured, appropriately and beautifully illustrated.

Nearly all of the magnificent mountains I have ever read about, seen or had the pleasure of climbing, appear to be mentioned in this book. The text wanders over mountain ranges and peaks across the globe, drawing in cultural, religious, cartographic, artistic, scenic, biographic and much historic and geographic data. It weaves a tapestry of anecdotal information, myths, linguistic detail, personal observations and scientific facts, and includes 137 illustrations, many of which are in colour. Be prepared to learn much more about mountains that you never knew before, from a book that is a very well-illustrated 'cracking good read'.

Reviewed by: ***Chris Carlon***

**MOUNTAIN: NATURE AND CULTURE**
by Veronica della Dora, 2016. Published by: Reaktion Books Ltd. 264pp
ISBN: 978 1 78023 647 6
**List Price: £14.95 W: www.reaktionbooks.co.uk**

## Industrial Structural Geology

Structural geology is an integral and influential discipline applied across a spectrum of geosciences. Concepts and techniques derived and developed from structural geology are routine components in numerous areas of geoscientific investigation, ranging from the petrological thin section to the analysis of data derived by remotely sensed satellite observation.

The scale of the discipline is of particular relevance when applied to the activities of the natural resource industries (especially the hydrocarbon, mining and hydrogeology sectors), where subsurface definition, quantification and extraction (or storage) of industrial or economic resources is essential. Common examples of the industrial applications of structural geology include the interpretation of borehole-derived and seismic data to define the architectural geometries of hydrocarbon and mineral deposits, enabling the quantification of these resources and evaluate potential economic (and safe) techniques for their extraction.

With contributions from workers within academic institutions, consultancies and industry, this Special Publication provides a comprehensive synthesis of the current trends and predicted future direction of structural geology as applied to natural resource/industrial contexts.

Introduced with an overview paper from the editors, the volume presents 16 papers organised into three fully-indexed thematic sections: industrial structural principles, industry techniques and workflows and structural integration and case studies from industry. Diverse topics covered include trap definition, fault seal, fold-and-thrust belts, fractured reservoirs, fluid flow and geomechanics.

In summary, the volume demonstrates the current and continuing significance of the techniques of structural geology to the resource industries (particularly within hydrocarbon exploration and production), and the applicability of these techniques at all scales and 'lifetime' stages of a resource. The volume additionally provides substantive insights into how structural geological 'theory' translates appropriately into industrial 'practice'.

Providing an excellent overview of the 'state of the art' pure and applied developments within this important and evolving field, the expected audience is anticipated from both academic and industrial sector geoscientists. The contributions are well-written and edited, complemented with appropriate figures, photographs and data-tables, features that one has come to expect from the GSL Special Publication series. The editors and contributors are to be congratulated. A recommended read.

Reviewed by ***Mark Griffin***

**INDUSTRIAL STRUCTURAL GEOLOGY: PRINCIPLES, TECHNIQUES AND INTEGRATION**
by RICHARDS F L, RICHARDSON N J, RIPPINGTON S J, WILSON R W AND BOND C E (eds). Geological Society of London Special Publication No. 421. 2015. Geological Society of London. ISBN 978-1-86239-733-9. Hbk. 267pp. ISSN 0305-8719.
**List Price: £100.00 (Fellows' discount applies)**
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## BOOKS FOR REVIEW

Please contact **ted.nield@geolsoc.org.uk** if you would like to supply a review. You will be invited to keep the review copy. See a full up-to-date list at **www.geolsoc.org.uk/reviews**

- **NEW! The Mountains of Iron - a history of iron mining industry in Mid Antrim** by Kevin J O'Hagan. 2017 140pp sbk
- **NEW! Quaternary Glaciation in the Mediterranean Mountains** by Hughes and Woodward (eds) SP #433 2017 Geological Society 315pp hbk
- **NEW! Seismicity, Fault Rupture and Earthquake Hazards in Slowly Deforming Margins** by Landgraf et al (eds) 2017 Geological Society 261pp hbk
- **NEW! Crust-Mantle Interactions and Granitoid Diversification** by Halla et al., 2017 Geological Society/IUGS SP449 256pp (hbk)
- **NEW! The Andaman-Nicobar Accretionary Ridge: geology tectonics & hazards** by Bandopadhyay and Carter (eds) 2017 Geological Soc. Mem.#47 237pp (hbk)
- **NEW! Curbing Catastrophe - natural hazards and risk reduction in the modern world,** by Timothy Dixon. Cambridge UP,300pp, hbk
- **NEW! Women in Science - 50 fearless pioneers who changed the world** by Rachel Ignotofsky.127pp, hbk
- **NEW! Unearthed - Impacts of the Tellus Surveys of the north of Ireland** by Mike Young (Ed) 423pp, sbk.
- **Asteroids - Astronomical & Geological Bodies,** by Thomas Burbine. 2017 Cambridge Planetary Science 367pp, hbk
- **Land Surface remote Sensing,** by Baghdadi N and Zribi M (eds). Elsevier 2017 342pp hbk
- **Integrated Environmental modelling to Solve Real World Problems. Geol Soc Spec pub #408, 2017** by Riddick et al (eds)
- **Petroleum Geoscience of the West Africa Margin. Geol Soc Spec. pub. #438, 2017** by Sabato Ceraldi et al (eds)
- **Waves, Particles and Storms in Geospace** by Balasis et al. 2016 Oxford University Press 448pp hbk
- **Lake Pavin - History, Geology, Biogeochemistry and Sedimentology of a Deep Meromictic maar lake,** by Sime-Ngando et al. (eds) 2016 Springer. 421pp, hbk

# DISTANT THUNDER *Material matters*

***As geologist and science writer Nina Morgan* discovers, a little geochemistry goes a long way***

Archibald Geikie (1835 – 1924), cut his geological teeth with studies in Edinburgh and the Hebrides, and in the 1860s worked with Roderick Murchison (1792 – 1871) to untangle the complex geology of the northwest highlands. Although the Murchison – Geikie interpretation was debunked by the work of other geologists in the 1880s, Geikie went on to become director of the Scottish Geological Survey in 1882.

Geikie had many other strings to his bow. He was a gifted writer and author of a number of textbooks and popular books about geology. In addition, he was keen observer of geology in the urban environment. In his book, *A Long Life's Work: An Autobiography*, he recalled:

"In the course of my journeys all over Scotland there was always an interest in examining the tombstones in graveyards, first for the light which they so often throw upon the families that have lived for generations in a district... and next for the valuable and unexpected information which they frequently afford as to the manner and rate of decay which various kinds of stone, employed for monumental purposes, suffer from the disintegration effects of the atmosphere."

## Losing your marbles

His observations on weathering in gravestones soon led him to conclude that acid rain – essentially carbonic acid ($H_2CO_3$) formed when carbon dioxide ($CO_2$) emitted from the burning of coal was dissolved in rain water – was a major culprit. The effects, he noted, were especially obvious on marble, a stone often chosen for high-status graves. As an illustration, he cites the degradation of the gravestone in Greyfriars churchyard in Edinburgh honouring the chemist Joseph Black (1728 – 1799).

"This sumptuous tombstone," Geikie noted, "consisted of a solid framework of hard siliceous sandstone into which a large upright slab of white marble had been firmly fastened, recording in Latin, with pious reverence, the genius and achievements of the discoverer of Carbonic Acid, and Latent Heat, and adding that his friends wished to mark his resting place by the marble while it should last."

No doubt those well-meaning, but perhaps chemically illiterate friends imagined the marble would last a lot longer than it did. When Geikie visited Black's grave in 1879, less than 80 years after it had been erected, he noted that the inscription on the marble was becoming illegible and worse:

"...The slab, still firmly held in place by the metal fastenings all round its margin, had bulged out considerably in the centre, forming a large blister-like expansion, which had been rent by numerous cracks."

By 1894 the marble had crumbled so badly that the Town Council of Edinburgh was forced to replace it with a slab of what Geikie described as a "far more durable sandstone, on which the original epitaph had been carefully copied."

## Fit for purpose

The Council clearly recognised that Black's gravestone was worthy of preservation. But it would be difficult to justify spending considerable sums on renovating marble monuments to 'ordinary' citizens. Banning of the use of marble – seen as a prestigious material – for churchyard gravestones would certainly have proved unpopular. So when it came to honouring the dead, what was a town council to do?

Geikie had an answer. "A cynic may say that, in the vast majority of cases, it will be no great matter if, at the end of a hundred years, a marble monument has become illegible, or fallen to pieces, and that people may be allowed to put up memorials in this perishable material which in most cases is likely to last at least as long as the memory of the deceased." So much for immortality!

**Acknowledgement**
Sources for this vignette include: A Long Life's Work: An Autobiography by Sir Archibald Geikie, Macmillian, 1924; the Wikipedia entry for Joseph Black; and the Dictionary of National Biography entry for Sir Archibald Geikie by David Oldroyd. I also thank the Haslemere Educational Museum for making available Geikie's field notes about Greyfriars Churchyard.

*** Nina Morgan** is a geologist and science writer based near Oxford. Her latest book, The Geology of Oxford Gravestones, is available via www.gravestonegeology.uk

## IN MEMORIAM WWW.GEOLSOC.ORG.UK/OBITUARIES

**THE SOCIETY NOTES WITH SADNESS THE PASSING OF:**

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Jenner-Clarke, Hugh Clifford David *
**Marshall, Mr John A ***
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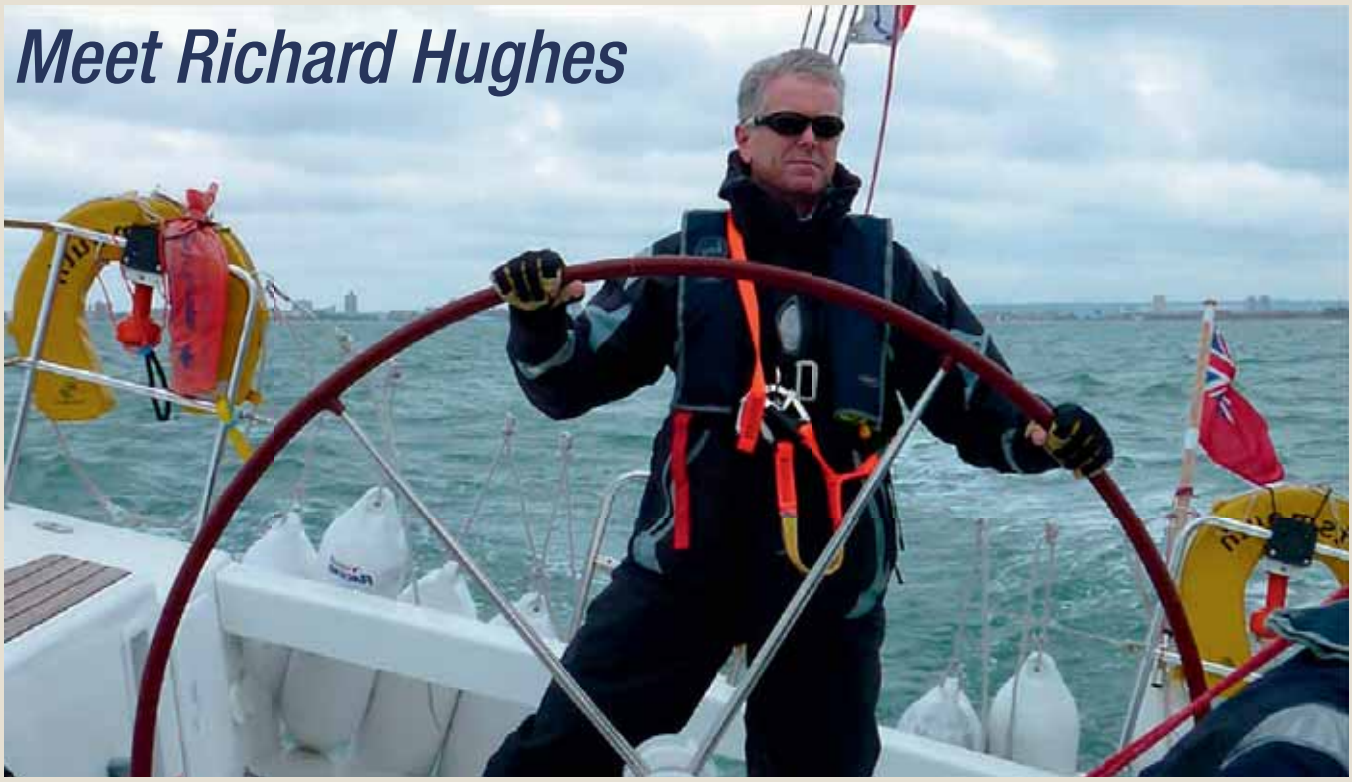
Wright, Ernest *

In the interests of recording its Fellows' work for posterity, the Society publishes obituaries online, and in *Geoscientist*. The most recent additions to the list are in shown in bold. Fellows for whom no obituarist has yet been commissioned are marked with an asterisk (*). The symbol § indicates that biographical material has been lodged with the Society.

If you would like to contribute an obituary, please email ted.nield@geolsoc.org.uk to be commissioned. You can read the guidance for authors at **www.geolsoc.org.uk/obituaries**. To save yourself unnecessary work, please do not write anything until you have received a commissioning letter.

Deceased Fellows for whom no obituary is forthcoming have their names and dates recorded in a Roll of Honour at **www.geolsoc.org.uk/obituaries**.

# Meet Richard Hughes



**Two Welshmen meet on St David's Day. Unsurprisingly, there is a pub involved. Ted Nield talks to the incoming Executive Secretary, who begins work this month.**

"Welsh, yes, and proud of it – born in Wrexham, brought up between there and Llangollen, where my father was a baker. We had a summer cottage in north-west Wales – Tremadoc – so I spent my formative years in two classic areas of British geology, and it left an indelible mark, I think.

"Then at 16, my mother dragged me along to a careers adviser, who asked: 'So, what do you like, young lad?'. I answered 'Geology'. And he said: 'Well you can forget that because you'll never get a job in it!'

"So I duly took his advice and didn't study geology at A level; but, when I went to Cardiff (to do Chemistry and Zoology), there was an opportunity to take the subject I had always been most interested in. I decided geology was for me, and did that instead."

This was the moment, about 35 years ago, when Richard Hughes and I first met, in a Friday afternoon palaeontology practical, at which I was demonstrating. I had finished by the time he graduated, however. So, what happened next?

"Well, after graduation, I had a few offers of PhD projects: one in Cardiff with Bill Dean and another with Derek Ager in Swansea. But there was one from Barrie Rickards at Cambridge, which promised a mix of mapping and structure in Upper Ordovician rocks in Wales, palaeontology, biostratigraphy and with interesting implications for Scotland, Scandinavia and Canada. It was a sort of 'multidisciplinary' PhD - the sort that probably don't get funded these days!

## BGS

"So I completed that within the three years – I was eager to get a proper job! - and was duly offered one with BGS where I stayed for well over 20 years. One of the great things about a big organisation like BGS is that, as long as you are flexible, interested in different things and are prepared to move around, there are many opportunities. So, within that time I had 5 or 6 different roles; though I started off as one of that endangered species, a mapping geologist - working in an area of North West England that basically hadn't been mapped properly, if at all, since the 1840s.

"I did that out of Keyworth, and then relocated to the regional office in Newcastle upon Tyne (to work on coalfield geology, but I also found myself involved with BGS's Lake District Lower Palaeozoic Project for a couple of years. This was the time when NIREX was investing heavily in the idea of a waste repository at Sellafield, and I had quite a bit to do with that - which gave me experience of a much more applied form of geology.

"I had always been interested in international work too, and I soon had the chance to work abroad, too - in Ecuador. My wife and I – she's a PhD physicist... we met in Cambridge - spent about two years in Ecuador with our son; but my involvement lasted over five years. Our second child - a daughter - was born there. I loved the scale of it – essentially, a World Bank-Funded project to map the Western Cordillera of the Andes, from Peru to Columbia, in a four or five-year period. It was a pretty epic challenge, with all sorts of – unexpectedness: such as, a complete lack of topographic base maps, and no satellite or aerial photo images! Luckily, GPS was just coming on stream; and, as exploration geologists do, we improvised.

"The project was all about bringing inward investment to Ecuador's minerals industry. To the North, there's Colombia - dripping with minerals; to the south, Peru and Chile, with world-class deposits of copper, gold and other precious metals. So, the thinking was – 'where are they in Ecuador?' The Ecuadorian government took a World Bank loan, and with some ODA money, engaged BGS to find out.

"It was life-changing. It wasn't just interesting geologically; it was culturally

fascinating. We took the opportunity to travel widely. It was here that I learned Spanish. It became a big chunk of my life - I was still writing papers on it 10 years later. The area was all but unknown – a very different situation from the Lake District, where you pretty soon realise you are treading in the footsteps of generations of geologists before you! In the New World, even today, you are often the first. The geological opportunities are just terrific.

## Midland Valley

"Back in the UK, I relocated to BGS Edinburgh and took on a big project in the Midland Valley. Then an opportunity arose on the commercial side - bringing income into the Survey. So I got involved in international business development, first in Europe and then South America and Africa, for five or six years. This was great commercial experience (we won significant amounts from the World Bank, Regional Development banks, DfID and so on) as well as a chance to explore some pretty interesting parts of Africa.

"Also, I took BGS through a major review (the 2003 Science & Management Audit), which it came out of pretty well. I guess that did my stock no harm. It was certainly a major learning experience, and my real first involvement with NERC, the government and the directorate - the politics of UK science. Then in 2006 I moved into 'matters digital' at BGS, as Director of Information.

"It might sound dull, but looking back, I think two of the achievements I am most proud of are BGS's 'I-Geology' app, and the 'OpenGeoscience' website, both of which happened at this time, and which were my idea. This was also the time (mid to late noughties) that I chaired the Information Management Committee at the Society - four years - shortly after standing for, and being elected to, Council. This wasn't a thing that had occurred to me previously, despite being a Chartered Fellow and all that; but, you know how it is - you get a call out of the blue from Edmund Nickless, and the next thing you know... The remit included the Library, so I also found myself (rather reluctantly!) embroiled in the 2011 Library Review. I suppose I had some relevant experience here from BGS, because I had been involved with the restructuring of Library provision there.

## Coal Authority

"Being Director of Information was my last role at the Survey - I resigned in 2013 and moved to the Coal Authority as Director of Business Development. BGS is a fantastic organization and I had a wonderful career there; but I felt I had probably taken it as far as I could. I often describe working at the Coal Authority as being like doing an on-the-job MBA - it's a business, run very much along commercial lines, within a strict governance framework. I have learned a huge amount about corporate governance, while helping to sort out the legacy of 300 years of UK mining.

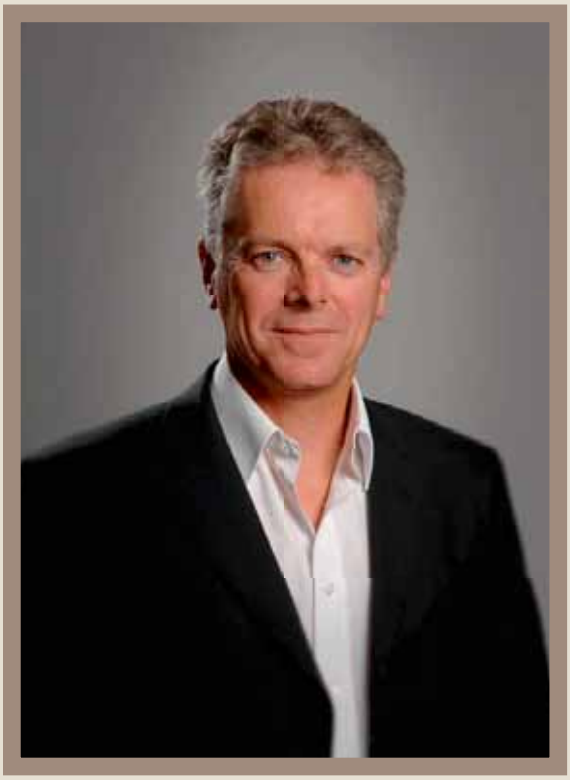
"One of the things that attracted me to the job was the fact that the Authority had clear strategy to make itself less dependent on grant-in-aid from Government and - as an arm's-length body – to become financially self-sufficient and commercially successful. My knowledge and track record in exploiting the commercial value of BGS's knowledge-base probably helped us go from zero to almost £2m of commercial income a year now."

With wife Catherine still teaching part-time, a son in the third year of a four-year Physics degree in Durham and a daughter in the second year of a Natural Sciences degree in Cambridge, there are no plans for the family to decamp *en masse* to London.

"We're now quite settled in the East Midlands. If I have any roots, other than Welsh ones, they are here. So I expect I'll take a *pied à terre* somewhere, and travel up for the week" Richard says, as we move on to talk about his new role in Burlington House.

"My work [at the Coal Authority] is of direct relevance to the Society, which needs to take a long, hard view of its finances. That observation is nothing new - it's up in lights in the existing financial strategy. Rather than being a 'three-legged stool', supported equally by publishing, membership and sponsorship, the Society's finance has become more of a two-legged stool - a pretty unstable item of furniture! We've become over-reliant on membership and publishing and need to develop our alternative income. I think my skills and experience in bringing money into not-for-profit organisations is particularly relevant.

"How successful the Society can be in attracting those income streams, I don't yet know. You can't create a market where none exists. But we have to be serious about it. There has been, I think, a tendency for committees to sit, deliberate, and come out with good strategic plans - but which lack the necessary underpinnings. What are those potential new income streams? How much might we need to invest in order to make them a reality? What would be the likely return on that investment? I have seen this before – and we will need to address it.



## Ambitious

"We could just cut our operation to suit our cloth, and hope that things get better; but I am much more ambitious for the Society than that. The Society does fantastic work - the content, for example, on the website. *Geoscientist* is brilliant, and the output of the Publishing House is world class. I would like to put the Society in a place where it can do a lot more of these great things.

"But the Society is still too London-centric. The geoscience community is fragmented into specialist and regional groups which seem to operate in isolation. I want to reach out to them, so that they can feel more as though they want to be part of a greater whole. And of course, we need to communicate, more effectively than we do, the benefits of geoscience research to life in general. But that is always true – a sliding scale, with no top! I am really looking forward to playing my part."

# *OBITUARY* Roelof van der Merwe 1959-2016

**Petroleum and structural geologist who became a prominent voice for ornithology and conservation in his native South Africa**

Roelof van der Merwe died unexpectedly in his sleep at his home in Waterkloof, Pretoria, in the early hours of Wednesday morning (23 December). He was 57 and is survived by his wife Willene, step-daughters Rachelle and Nini, Sister Elizabeth van der Merwe (Betsie), and mother Miems.

## Conservation

The evening before his death, van der Merwe had sent a festive season email message to his friends and acquaintances, urging them to greater conservation efforts in the coming year. Roelof was a generous donor to the BirdLife South Africa's seabird conservation, including sponsoring the organisation's Coastal Seabird Conservation Manager position. The private Charl van der Merwe Trust named after Roelof's late father was also "Species Champion" for the endangered African Penguin in BirdLife International's Preventing Extinction Programme, and supported WWF-SA's marine conservation work and EWT's raptor conservation work in the eastern Karoo, as well as conservation work on the Southern Ground Hornbill.

Roelof and his family trust had generously donated to BirdLife South Africa's seabird conservation work, including sponsoring the organisation's Coastal Seabird Conservation Manager position.

## Hero

Roelof was an unsung conservation hero who did not want praise and recognition. He was a passionate conservationist and deeply committed to efforts to conserve penguins, other seabirds, and the marine environment.

*Dr Roelof van der Merwe receiving the Bird Life International Conservation Achievement Awards from HIH Princess Takamado in 2013*

> "ROELOF WAS AN UNSUNG CONSERVATION HERO WHO DID NOT WANT PRAISE AND RECOGNITION. HE WAS A PASSIONATE CONSERVATIONIST AND DEEPLY COMMITTED"

Roelof van der Merwe trained as a geologist, completing his BSc (1982), Honours (1983), MSc (1986) and PhD (1994) at Rand Afrikaans University (now the University of Johannesburg) in structural geology under Profs Chris Roering and Jay Barton. Between 1990 and 1992 he worked in petroleum exploration for SOEKOR, before completing his PhD.

From 1995 to 2002 he was on the staff of the Geology Department at the University of Pretoria, as Senior Lecturer in structural geology, before taking early retirement to manage the family trust and pursue his passions of conservation, travel and wildlife photography. Roelof's commitment to structural geological education continued after he left the University of Pretoria, as he remained an extraordinary lecturer, and generously sponsored the Roelof van der Merwe prize for the best performing student in the undergraduate structural geology course, and the Dirk Visser prize for the best structural-based honours project.

## Photographer

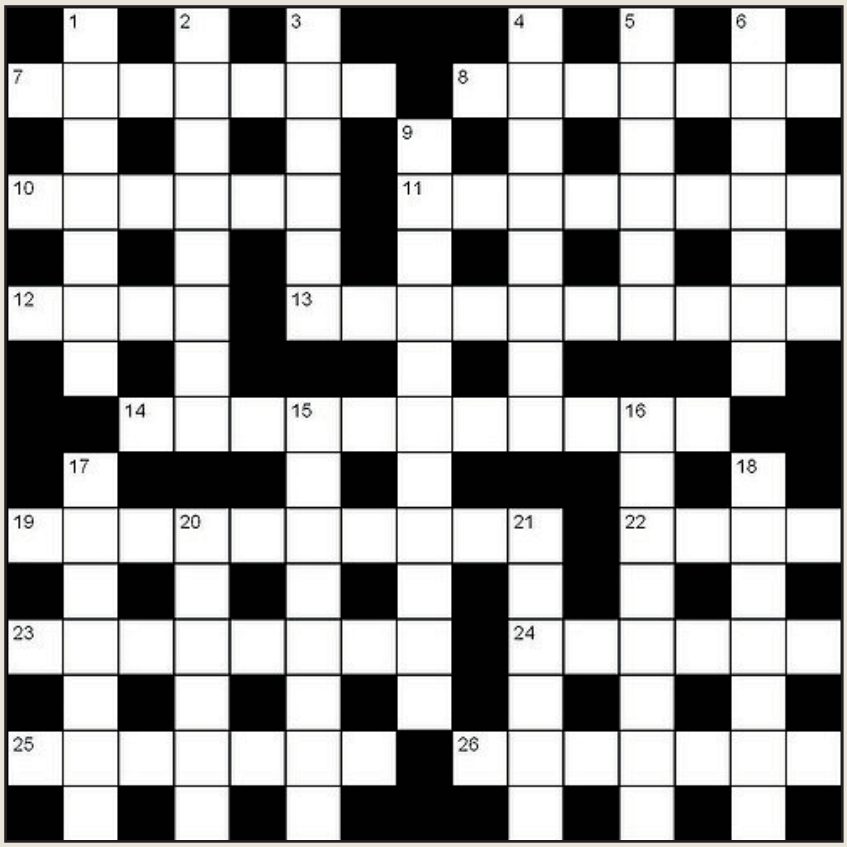
An accomplished birder and photographer, he travelled widely in pursuit of his passion, including several times to Antarctica. He was further a lover of good wine and dining and tasted the flavours of the world, including Lima, Peru, one of his last stop-overs on his way to the Galapagos Islands. He was a collector of model trains, a past chairman of the Tectonic Division and a Fellow of the Geological Society of Africa.

Our thoughts are with his wife Willene, step-daughters Rachelle and Nini, Sister Elizabeth van der Merwe (Betsie), and mother Miems. Roelof will be remembered by his family and friends for his humbleness and generosity.

By Andreas Rompel & Adam Bumby. Reproduced with the permission of the Geological Society of South Africa

***HELP YOUR OBITUARIST*** The Society operates a scheme for Fellows to deposit biographical material. The object is to assist obituarists by providing contacts, dates and other information, and thus ensure that Fellows' lives are accorded appropriate and accurate commemoration. Please send your CV and a photograph to Ted Nield at the Society.

## **CROSSWORD NO.214** SET BY PLATYPUS



### ACROSS

**7** Mathematical set that exhibits a repeating pattern displayed at every scale. (7)
**8** Critical reviewer (7)
**10** China clay (6)
**11** Water agriculturally (8)
**12** Underwent downslope mass movement under gravity (4)
**13** 'Upper mantle' rock, resembling peridotite, found in ophiolites and elsewhere. (10)
**14** Mentally improving (11)
**19** Living fossil fish found today around the Comores and Indonesia (10)
**22** Conjoined double crystal structure (4)
**23** Flat two-dimensional form of cultivated trained fruiting tree (8)
**24** Erasmus and Charles most illustrious species of this genus, though there are others. (6)
**25** County containing Ireland's oldest rocks exposed on the island of Inishtrahull (7)
**26** Fancy name for coffer (7)

### DOWN

**1** Able to be disintegrated into grains by the fingers (7)
**2** In meteorology - a cold front which has overtaken a warm (8)
**3** Sapropelic coal formed of spores or fine organic fragments (6)
**4** Ornamental composite used for floors and walls consisting of chips and cementitious binder (8)
**5** Eastern part of the Indian subcontinent at the apex of the eponymous Bay (6)
**6** Glassy object formed by melting of terrestrial material by a bolide (7)
**9** 200th birthday - 2007 in our case (11)
**15** Round and round in circles (8)
**16** The phenomenon of gemstones that exhibit a luminous star-like shape when shaped and polished. (8)
**17** Seasonally reversing wind accompanied by corresponding changes in precipitation. (7)
**18** Second most abundant element in the Earth's crust (7)
**20** Editorial pronouncement (6)
**21** Oldest Precambrian era (6)

# WIN A SPECIAL PUBLICATION!

The winner of the XXXXXX Crossword puzzle prize draw was **Robert Colin Pugh of Glossop.**

All correct solutions will be placed in the draw, and the winner's name printed in the July 2017 issue. The Editor's decision is final and no correspondence will be entered into.
**Closing date - May 19.**

The competition is open to all Fellows, Candidate Fellows and Friends of the Geological Society who are not current Society employees, officers or trustees. This exclusion does not apply to officers of joint associations, specialist or regional groups.

Please return your completed crossword to Burlington House, marking your envelope "Crossword". Do not enclose any other matter with your solution. Overseas Fellows are encouraged to scan the signed form and email it as a PDF to **ted.nield@geolsoc.org.uk**

**Name** .....

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**Membership number** .....

**Address for correspondence** .....

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**Postcode** .....

## **SOLUTIONS** MARCH

**Across:**
**7** Epibole **8** Hominid **10** Strain
**11** Brackish **12** Vein **13** Yield Point
**14** Adventurous **19** Supernovae **22** Iota
**23** Rheostat **24** Tuareg **25** Travail **26** Eoliths

**Down:**
**1** Spatter **2** Obtained **3** Flinty **4** Pomander
**5** Ginkgo **6** Dissent **9** Objectivity **15** Einstein
**16** Uniramia **17** Gushers **18** Utrecht
**20** Evolve **21** Eotvos

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British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

UCL IRDR

2017 YEAR OF RISK

# Building Resilience to Geohazards in the Face of Uncertainty

**7-8 September 2017**

## The Geological Society, Burlington House, London

The impact of natural hazards on society continues to grow. Tackling this challenge needs physical and social scientists working together with stakeholders and communities at risk. It needs new ways of working, often in complex settings and difficult environments, to achieve positive and sustainable change.

This meeting aims to capture the growing activity in this area and provide a platform for the discussion of new results from major multi-disciplinary programmes involving researchers who are taking up the challenge to understand geohazards, manage risk and increase resilience. It will bring together the physical and social scientists and other experts to address the role that geoscience and geoscientists can play in building resilient communities and informed policymaking, into the future.

## Call for Abstracts

There is a call for abstracts and oral and poster contributions are invited. Abstracts should be sent in a Word document to georgina.worrall@geolsoc.org.uk by 31 May 2017. The abstract should be approximately 500 words and include title and acknowledgement of authors and their affiliations.

## Keynote speakers

**Professor Jenni Barclay**
(University of East Anglia, PI for Strengthening Resilience in Volcanic Areas)
**Professor James Jackson**
(University of Cambridge, PI for Earthquakes without Frontiers)

## Convenors

**Susanne Sargeant** (British Geological Survey, Increasing Resilience to Natural Hazards Knowledge Exchange Fellow)
**Peter Sammonds** (University College London, Increasing Resilience to Natural Hazards Strategic Advisor)
**Anna Hicks** (British Geological Survey, Strengthening Resilience in Volcanic Areas)

## Further information

For further information please contact: Georgina Worrall, Conference Office, The Geological Society, Burlington House, Piccadilly, London W1J 0BG

T: 0207 434 9944 E: georgina.worrall@geolsoc.org.uk

Web: www.geolosc.org.uk/buildingresilience17

Follow this event on Twitter: #geohazards17

# Setting the Pace


*Results from Dan Field Ocean Bottom Node (OBN) Survey – A Shallow Water Case Study. Zaske *et al.*, EAGE Conference (2014)

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